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Issued February 27, 1913.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 254.

B. T. GALLOWAY, *Chief of Bureau.*

THE PERSIAN WALNUT INDUSTRY OF THE UNITED STATES.

BY

E. R. LAKE,

Assistant Pomologist, Pomological Collections.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1913.

Monograph.

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A WELL-KEPT PERSIAN WALNUT ORCHARD IN CALIFORNIA, ILLUSTRATING THE THOROUGH TILLAGE THAT MAY BE READILY MAINTAINED AMONG LOW-HEADED TREES.

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E. R. Lake, *Assistant Pomologist.*
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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., July 1, 1912.

Sir: I have the honor to transmit herewith and to recommend for publication as Bulletin No. 254 of the series of this Bureau the accompanying paper, entitled "The Persian Walnut Industry of the United States," by Mr. E. R. Lake, Assistant Pomologist, Pomological Collections, Bureau of Plant Industry.

The consumption and price of walnuts in the United States have greatly increased during the past decade, while the output of the home-grown product has been practically at a standstill, though rather extensive plantings have been made during the past ten years. The purpose of this paper is to explain in terms of actual orchard conditions why this apparent anomaly exists, and to present the best information obtainable as to the methods of making it possible to extend the area of successful cultivation of this nut. It aims further to answer the many questions now being propounded by a public that has been stimulated by alluring promises of marvelous incomes from orchard plantings of this tree.

Secondary aims of the author have been to describe the varieties of *Juglans regia* in such a manner as to make it possible for a layman to identify the known varieties and at the same time to lay the foundation for a systematic classification of this nut, to the end that a better knowledge of types and varieties will enable the planter to avoid many of the costly errors of the past.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

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B. P. I.—752.

THE PERSIAN WALNUT INDUSTRY OF THE UNITED STATES.[1]

INTRODUCTION.

The Persian walnut, more generally spoken of as the English walnut, came into cultivation in western Europe by way of Greece. The early Greek names "Persicon" and "Basilicon," applied to this nut, imply that is was either "brought from Persia by the monarchs of Greece or sent thither by the kings of Persia." Later the Greeks called it "Caryon, on account of the heaviness of the head which its strong odor caused."

The tree was really first brought into cultivation in Italy with the dawn of the Christian Era. Prior to this time the nuts were an article of commerce coming to Rome and other western marts under a multiplicity of names from Greece and the interior of Asia Minor. Particularly did the names used by early authors, like Grenoble or Sorrento of to-day, which designate localities or even shipping points, indicate the region known as Pontus in Asia Minor as the source of this nut.

As verifying the view that the walnut was not cultivated in Europe prior to the birth of Christ, Hehn in his book entitled "The Wanderings of Plants and Animals" says:

> In any case the want of settled names for these nuts proves that there was no general cultivation of these trees (almond, chestnut, and walnut) in Italy at the time of Cato, 234–149 B. C., though the walnut is mentioned several times by Varro, 116–27 B. C., and once by Cicero, 106–43 B. C., who relates that the daughters of Dionysius singed that tyrant's beard off with red-hot nutshells.

That the walnut was cultivated in other regions prior to the time the Romans introduced it into Europe is the opinion of De Candolle, who states that the Arabs knew it as Jouz or Jown at an earlier date.

[1] The writer desires to express sincere thanks to all those who, by contributions of data, specimens, or other material, have rendered valuable aid in the preparation of this bulletin. Especially to the following is he indebted for numerous favors: Prof. C. W. Beers, P. J. Berckmans Co., Leonard Coates, Dr. W. W. Fitzgerald, C. B. Franklin, Ferd Groner, L. C. Hall, Ely I. Hutchinson, F. A. Leib, M. McDonald, Dr. Robert T. Morris, J. B. Neff, George C. Payne, Pomeroy Bros., E. M. Price, Thomas Prince, J. G. Rush, C. C. Teague, Tribble Bros., the Vrooman Estate, E. G. Ware, and R. Wiltz.

The same author asserts that both the Bohemian name Oresak and the Biscayan name Encauria indicate that this tree was cultivated before the days of the Roman emperors. The Greek word "eros," which is found only once in the Bible, is held to be the term used to designate the walnut at that remote date.

It was during the imperial days of Rome, when it was commonly known as Jove's nut, Jupiter's acorn, or the nut of the gods, and used in the ceremonials associated with weddings, that the walnut was first distinguished by the name Juglandes. As an instance of the confusion that existed as to its name prior to this date, and which would appear to imply that only the crudest form of cultivation, if any at all, was accorded the walnut at that period, we find that "the popular name Jupiter's acorn, *Dios balanos*, which in Greek meant chestnut, has in the corresponding Latin form Juglans (Jovi-glans) the meaning of walnut."

The term "walnut" is a corruption of "Gall nut," the name under which the product of the trees of Gaul, the ancient name of France and adjacent territory, was marketed. It was probably first used by the Germans to designate the product as "the foreign nut."

The chief credit for bringing this tree under cultivation appears to belong to Vitellius, a Roman emperor, A. D. 39. Once established upon the soil of Italy it made rapid progress into the adjacent parts of Europe, being disseminated throughout the various territories covered by the Romans in their several northern and western invasions and remaining to bless the land as one of the beneficent incidents of devastating war after the conqueror had been conquered.

Though this tree, which is now known to science as *Juglans regia* and the product of which has been known successively or collectively to the trade as Persian, royal, Madeira, French, English, California, and even Oregon walnuts, was probably introduced into cultivation from Persia, it has been found growing in a state of nature in widely separated sections of the mountains of southwestern Asia, including northern India, southern China, Asia Minor, Afghanistan, the Caucasus, and in portions of southeastern Europe adjacent to Asia. Evidences of an even wider distribution of this tree in geologic ages is afforded by the fossils of the Tertiary period, which according to M. de Saporta show that it formerly existed in Provence and elsewhere in the southeastern portion of France. Other species of Juglans are catalogued from Jamaica, Spain, North and South America, Cuba, Japan, and Australia. At present it may be said that Juglans, through its various species, encircles the globe in the following manner: Eastern shore of Asia, *Juglans sieboldiana* and *J. cordiformis*, the Japan walnuts; western Asia and eastern Europe, *J. regia*, the royal walnut; eastern America, *J. nigra* and *J. cinerea*, the black walnut and the white walnut or butternut; western

America, *J. californica*, the California black walnut. There are two quite well-defined forms of *J. californica*. The northern form is a large tree, while the southern form usually assumes the habit of a large shrub. In the following pages reference is made to the northern form only. These species, together with the northern Chinese walnut (*J. mandshurica*), the Cuban walnut (*J. insularis*), the rock walnut of Texas (*J. rupestris*), three Mexican species, and those of South America afford evidence of adaptability to a wide range of environment.

DESCRIPTION OF THE PERSIAN WALNUT TREE.

The Persian walnut tree under favorable soil and climatic conditions is of large growth and long life. The following statements taken from the Gardeners' Chronicle, London, England, are cited as instances of the great growth and age to which this tree may attain:

> The famous old Beachemwell tree in England had the following recorded dimensions: Height, 90 feet; spread, 120 feet; height of trunk, 10 feet; diameter of trunk, nearly 10 feet; yield of nuts in one season, 54,000.
>
> The colossal tree that grew in the Department of Lot in France lived to be at least 300 years old, with a spread of 125 feet, a trunk 20 feet high and 14 feet in diameter. Its crop record was 15 bags a year on the average.
>
> The giant walnut that stood in Baidar Valley, near Balaklava, in the Crimea, reached the age of 1,000 years, and for a long time yielded annually 80,000 to 100,000 nuts, the joint property of five Tartar families, who shared its product equally.

In California, trees reputed to be approximately 140 years old, and with trunks 4 feet or more in diameter, are to be seen in the oldest missions. In some of the larger commercial orchards, from 35 to 40 years old, are to be found many trees with trunks 2 feet in diameter and a spread of 80 feet.

One of the successful growers of Carpinteria, Cal., Mr. C. B. Franklin, has said that he can see no reason why a walnut orchard in that locality should not continue to bear profitable crops until the trees are 150 to 200 years old, provided they are given good care and planted at least 45 feet apart on deep, mellow, rich soil.

In a more conservative view, however, F. E. Kellogg, of Santa Barbara, Cal., who has been intimately associated with the growth of at least two of the pioneer orchards of the State, is firmly of the opinion that the profitable life of a walnut orchard may be extended to 35 years if the trees are planted 50 to 60 feet apart on good, well-drained soil. This statement is not intended to imply in the least that individual and scattered trees may not bear profitably much longer. In fact, so far as authentic records are available, the data that pertain to exceptional longevity, enormous size, and extraordinary yield relate to single, isolated trees.

It may be said in this connection that the foregoing opinions of Mr. Franklin and Mr. Kellogg are based upon their knowledge of the conduct of seedling trees, grown under the conditions existing in southern California. Notwithstanding the somewhat divergent views as to the period of profitable fruitfulness and the distance between the trees, the consensus of opinion is to the effect that in vigor, size, and longevity the walnut exceeds any other of our commercial orchard trees. As a crop for long-time investment under a suitable environment, it offers attractions and inducements that are scarcely equaled by any other. Acre for acre, few individual trees are required, thus minimizing the loss from individual weaknesses. Modern methods of propagation assure a uniform product. The steady increase in crop output until the trees have reached a considerable age (at least half a century) insures an accumulating income. The comparative freedom from serious enemies save one, the blight, reduces very materially the probable loss of crop or the serious reduction of quality values.

THE CROP AND ITS USES.

NUTS AS FOOD.

The chief uses of the walnut are as food, mainly dessert and confections, though during the past few years, with the growth of the movement looking to the introduction of a larger element of vegetable products into our dietary, it has become an important element in the composition of many substantial table preparations. Large quantities of the lower grade nuts grown in Europe are expressed for oil, but very few of the nuts grown in the United States are used for this purpose. Walnut oil is highly esteemed in France and in some instances is used in preference to that of the olive. It is also rated high as a drying oil for artists' use. In Europe considerable quantities of young walnuts are used for making pickles and catchups, and though inquiries for such preparations have been made recently in the United States it is found that they are not produced in commercial quantities from American-grown nuts. As an article of confection the smaller walnuts find a ready sale, and large quantities are annually consumed.

The first effort by an American firm to put the cracked nuts upon the market in commercial quantities was made with the crop of 1910, when a Los Angeles firm purchased large quantities of culls at 2½ to 3½ cents per pound and after putting them through an improved power cracker sold about 25 tons of assorted meats. The market price was 35 cents per pound for the unbroken meats and 28 cents for broken meats. The shells were sold for fuel purposes at 20 cents per sack. The very dark, black, and blighted meats were disposed of as stock food, though steps have been taken to ascertain whether

much of this low-grade material can not be used for making oil. In this connection an excerpt from the correspondence with this office of one of New York's largest and most exclusive importers and wholesale grocers, commenting upon the relative selling value of the American and French walnut products, may be pertinent to the topic under discussion.

> We were interested in the American cracked product last year (1910) principally because we could get it about two weeks before the foreign nuts arrived. This enabled us to distribute before the Thanksgiving holidays, which is a season of large consumption. Later in the year when the foreign nuts began to arrive we purchased chiefly of these, as they were more uniform in size, whiter in color, and more carefully assorted. Some years, as in 1910, it is found that, of uncracked nuts, the Grenoble, which is the best of the foreign nuts, is of higher quality than the home-grown nut; in other years it is the reverse. With the cracked nuts there is little, if any, choice as to quality, though there may be considerable in the respects noted above. Seasonal climatic conditions apparently have much influence upon the quality of the walnut.

Of this last remark something more may be said at this time, since seasonal variations in the quality of the product seriously affect the commercial stability of the crop. A notable instance of this character has been observed in the two crops of Manchurian nuts that were imported during 1910 and 1911. The importation of 1910 proved to be a fair quality hard-shell nut that cracked well, while the crop of 1911 was exceedingly disappointing, especially to the importers, who were losers by the transaction. The crop of 1911 cracked badly and, besides, yielded a larger percentage of poor-quality nuts as compared with the 1910 crop. Similar experiences followed the importation of Chilean nuts, which were formerly imported in considerable quantities. Even with the European crop there are wide variations in quality from one year to another.

OIL.

Thus far, little effort has been made to convert the American product into oil, probably owing to the fact that heretofore the quantity of inferior nuts has been very limited, or at least in the process of grading they have not been separated from the better quality nuts.

With the closer grading that will inevitably accompany an increased output, a higher price scale, and a more systematic handling of the crop there will be a distinct and appreciable quantity of culls that must be utilized; hence, the importance of an establishment for the conversion of the low-grade material heretofore of uncertain market value into products of recognized market ratings of moment.

For the past 20 years a grower in the southern California district has annually converted about 1,200 pounds of culls into oil for home use, and finds that each year it is increasingly appreciated

as an article of food and medicine. As a result of this experience in expressing oil from the California product the following data are offered those who would utilize the culls. Good oil can be made only from sound nuts, though in commercial terms they may be culls. In other words, rancid, moldy, or partly decayed meats are not suitable for oil making. The nuts must be thoroughly dry before being expressed. Nuts, the kernels of which have been blackened through sunburn, are suitable for oil making, and such oil will be good, provided it is carefully clarified. The best oil is obtained from kernels that are plump and white, or at least of light color. Of the several varieties tested by the grower referred to, the Placentia has given the best results. A sack of the culls of this variety as offered in its home district, Orange County, Cal., weighs about 50 pounds and cracks about 25 pounds of meats, which expressed for 24 hours will yield 12 pints of excellent oil. For average culls, all varieties and one year with another, 25 pounds of meats yield 1 gallon of oil. Culls usually yield from 15 to 20 pounds of meats for each 50 pounds of nuts. Shriveled meats are as good as plump ones, but the quantity of oil in them is less. Oil experts have pronounced the oil from the soft-shell superior to that from the hard-shell varieties, though pound for pound the kernel yield is about the same. In any event care and cleanliness must be exercised in making the oil; otherwise the quality of the meats will count for naught. Under present conditions nuts are more profitably sold at 10 cents per pound than expressed into oil.

PICKLES.

Large quantities of immature walnuts are imported into the United States from Holland and England for use as pickles, catchups, sauces, and flavoring material. The nuts after being processed and barreled in brine are shipped in 70-gallon casks at a cost to the importer of $15 to $18, duty and freight included. There is no doubt that this part of the market demand for walnuts could be supplied by our own growers if on trial the cost of production permitted.

For pickling, the nuts are gathered when tender enough to be easily pierced by a large pin. At this stage they are entirely free from woodiness, a prime requisite for high-quality pickles. When picked the nuts are placed for nine days in a brine consisting of 4 pounds of salt to 1 gallon of water, renewed on the third and sixth days. On the tenth day the walnuts are removed from the brine and exposed to direct sunlight about two days until perfectly black. Sometimes the nuts are treated with dry salt instead of brine. This treatment, it is claimed, blackens them without exposure to sunlight. After the nuts are fully blackened they are placed in clean, dry jars

and covered with hot, spiced malt vinegar, to each quart of which are added 2 ounces of whole pepper and 1 ounce each of allspice and bruised ginger root. Sometimes a few shallot onions are added to the boiling vinegar. After the jars are filled and the tops screwed down they are placed in a cool, dry room and in a month are ready for use, though they may be kept for 3 or 4 years.

Taken at the same stage of growth as for pickling and boiled in a rich sirup, walnuts are said to make a delicious and delicate sweetmeat.

DISTRIBUTION AND AREAS OF CULTURE.

CULTURAL RANGE.

As indicated by its variable natural habitat, the walnut may be grown over an extended area, though the profitable production of a high-class nut is confined to relatively narrow limits in a few widely separated regions—France, Italy, Germany, Austria-Hungary, Russia, China, Chile, and the United States. Though grown with commercial success in these countries, it is only in restricted areas of each that the choicer grades are produced, notably in the Grenoble district, France, in the vicinity of Sorrento, Italy, and in southern California.

That this nut is not grown successfully over a more extended area has been largely due to the absence of a thorough effort at improvement and adaptation, there having been practically no advance in varietal improvement since the origin of the Franquette, over 100 years ago. Likewise, there has been only one notable instance of adaptation through selection, the Santa Barbara soft-shell, unless we take cognizance of the recent evidence of blight-resistant varieties in southern California. Within the past five years considerable impetus has been given the idea that the area of profitable walnut culture in the United States may be largely extended through the employment of other stocks than its own upon which to work the choicer and more hardy varieties of the Persian. Careful consideration of varietal requirements and adaptation by selection materially advance the view that the walnut may be commercially grown over a considerably wider area than was formerly supposed.

Various though not extended tests demonstrate that several of the leading commercial varieties of *Juglans regia*, the Persian walnut, when worked upon the American species *J. nigra* and *J. californica* may be successful in regions where formerly the Persian was a failure. The native stocks being more resistant to drought, heat, excess of moisture, alkalis, and unseasonable and severe changes in temperature, makes it possible to utilize a much greater range of soil and

climatic conditions than has been deemed possible. Not only has the work with the American stocks given excellent results, but some very remarkable developments have followed the work of top and crown grafting upon certain hybrids originating in California, notably the Paradox and Royal. The Paradox is the offspring of a cross-pollination between *J. regia* and *J. californica*, while the Royal is the offspring of a cross-pollination between *J. nigra* and *J. californica*. These hybrids are characterized by an extraordinary vigor of growth, in many instances a year's growth of 12 to 15 feet as against half as much in the parents. Like the native species, these hybrids are hardier than the Persian walnut and not so subject to injury by early spring changes in temperature, which, through starting and checking a premature flow of sap, seriously damage the younger wood and blossoms. Grafted upon these hybrid stocks, the Persian walnut makes a remarkable growth and so far as tests with them have been made gives promise of early and abundant fruitfulness.

Serious defects appear in these hybrids in that while a few trees are reported prolific they are generally indifferent bearers and that the seedlings grown from the nuts vary greatly in vigor, in some instances not over 20 per cent being first class. Though this makes it necessary to grow a large number of seedlings for a small quantity of first-grade stock, some propagators consider the expense repaid by the exceptional vigor of the seedlings, surpassing the native blacks or the Persian. This view is strengthened by the observation of F. A. Leib, an extensive experimenter in the propagation of the walnut, who says:

> On the root depends the entire success of the orchard, and after an extended investigation we are convinced that the nuts of certain of our hybrids produce trees that surpass all others in sturdiness, adaptability, and rapidity of growth.

Of Mr. Leib's statement it may be said that, while he attaches great importance to the value of the root, or stock, and his words even imply that the whole credit of successful growth is due to the root, in his own practice he uses every precaution in the selection of scions, thus doubly insuring the production of a successful tree.

Mr. Payne, an observer, propagator, and grower of the walnut, is of the opinion that the merits of these hybrids are not yet fully determined. He says:

> I have noticed that in dry seasons the Paradox seems unable to furnish as much moisture for the development of its crop as the native California black growing under the same conditions. The nuts in the instances observed were considerably smaller on the Paradox root than on the native black, and I ascribe this result to a shortage in the water supply. Of the seedlings from the two hybrids, those of the royal are by far better, though they vary widely in general character as to vigor of growth, foliage, and resistance, while some of them when grafted refuse to unite with the Persian scion.

Mr. Payne's observation is not yet verified by other propagators, and it is possible that local conditions may have been a determining factor in the results observed by him. Should his observation as to the inability of the hybrids to endure drought become established a great part of their prospective value as stocks would be lost and the native black walnuts would be the sole reliance upon which to predicate the future extension of the area of walnut orcharding in the United States.

RANGE BY STATES.

Alabama.—"The walnut has not been grown in this State with any degree of success, except in a small way. So far as the product of the tree is concerned, it is usually strong flavored and early becomes rancid." (*P. F. Williams, Alabama Agricultural Experiment Station.*)

Arkansas.—"It is reported that an English walnut tree near Little Rock has been fruiting for several years, and it is recommended that it be tried further in the cotton belt." (*Arkansas State Horticultural Society, Report, 1910.*)

Colorado.—"One tree of the walnut, variety unknown, is successfully growing near Boulder, on the mesa near the foothills. There are no commercial plantings of this nut in the State to my knowledge." (*D. M. Andrews, Colorado.*)

District of Columbia.—In various parts of the District of Columbia are to be found large, thrifty seedling trees of the Persian walnut, but as far as examined, with one exception, the Barnes, the fruit is of indifferent size and quality. The climatic conditions are such that the trees do not bear regularly, though in the case of the Barnes it is reputed to be a good bearer, considering its immediate environment.

Florida.—"It is agreed on all hands that *Juglans regia* has failed in Florida. Many report that the trees die before bearing, though I have heard of some that bore. It is not recommended by any of the nurserymen of the State. *J. cordiformis* and *J. sieboldiana*, on the other hand, flourish well in north Florida and bear profusely. But the shells of their nuts are so hard and thick that there seems no prospect of their fruit rivaling the thin-shelled varieties of *J. regia* as a commercial product. Of the two, *J. cordiformis* seems preferable. I am unaware of any attempt to grow Japanese walnuts on a commercial scale in Florida." (*John Belling, Florida Agricultural Experiment Station.*)

Georgia.—"In 1908 and again in 1910 we made an extended inquiry of southern planters and nurserymen as to the success of the walnut in the South. After giving the reports of their various correspondents careful consideration we can not recommend the planting of the English walnut for commercial purposes this side of the Rocky Mountains." (*P. J. Berckmans Co., Georgia.*)

Indiana.—Though a few trees of the walnut are reported as successfully fruiting in Indiana, no especial effort has been made to give it a thorough trial. During the past year, however, one or two enthusiastic citizens of the State have undertaken to give the subject an extended experimental test.

Louisiana.—"About 15 years ago I planted grafted trees of several varieties of *Juglans regia* obtained from Felix Gillet, of California. The stock used was *regia* and these trees are now all dead, although the Mayette tree lived until two years ago and had attained a height of 20 feet, with a trunk 5 or 6 inches in diameter. This tree bore pistillate flowers for several years, but set no fruit. I now have a Mayette tree, top-budded on black walnut, which seems healthy,

as does another of the Gillet varieties similarly worked. About the time that I planted the Gillet trees, Luther Burbank sent me a number of seedling trees of the Santa Rosa. One of these is still alive, but not more than 4 feet high. The native black grows and bears well here." (*B. M. Young, Morgan City, La., 1910.*)

Maryland.—"Maryland, except the two westernmost counties, and Delaware have been producing fairly good seedling Persian walnuts for 100 years, and there are many young, middle-aged, and very old trees with good bearing records. The soil and climate are adapted to hardy types of the Persian walnut, and a lively interest has been created in nut culture in these States in the last five years. A good many young walnut trees are being planted." (*C. P. Close, Maryland Agricultural Experiment Station.*)

Massachusetts.—"It can hardly be said that it [the Persian walnut] can be grown successfully in this State, although it is possible that a specimen growing in a particularly favorable location may live to become of considerable size." (*William P. Rich, secretary, Massachusetts Horticultural Society.*)

"It [the Persian walnut] does not succeed here [Amherst], and I know of no place in the State where it does." (*F. A. Waugh, Massachusetts Agricultural Experiment Station.*)

Michigan.—"I have a 16 or 17 year old Persian walnut tree that has borne every year for the past seven years. I also have trees 6 years old raised from nuts off this older tree, and I believe they will bear in another year. The parent tree is 26 inches in circumference and about 20 feet high." (*F. P. Andrus, Michigan, 1911.*)

Many other trees of this species, *Juglans regia*, have been planted in this State, if the records of nurserymen's sales may be relied upon, but we have been unable to obtain any record of their bearing.

Montana.—"The only English walnuts being tested in Montana, so far as I know, are a few varieties planted on our substation grounds at Corvallis. These have been out two years and have made a very unsatisfactory showing. Two or three trees out of 30 or 40 are alive at this time." (*O. B. Whipple, Montana Agricultural Experiment Station.*)

Nevada.—"To my knowledge, there is only one tree of the Persian walnut growing in the State of Nevada. This tree is somewhere between 15 and 20 years old and is growing near Franktown, Washoe County. It is about 60 feet high, with irregular branches, and bears abundant crops about once every four years and misses a crop about one year in seven. The nuts are smaller and have harder shells than the ones usually bought in stores." (*P. Beveridge Kennedy, Nevada Agricultural Experiment Station.*)

New Mexico.—"In New Mexico no record has been made of the planting of the walnut, yet *Juglans rupestris* grows naturally in several sections of the State, while *J. californica* is growing and fruiting successfully on the grounds of the experiment station." (*Fabian Garcia, New Mexico Agricultural Experiment Station.*)

New York.—Many trees of the Persian walnut are fruiting in this State, especially in the region tributary to Lake Ontario, about New York City, and on Long Island. Several of the older trees have yielded profitable commercial crops for the past 20 years. Recently many seedling trees have been planted throughout the State, and a few grafted trees are also being tried.

North Carolina.—Reports state that there are a few walnut trees growing indifferently in North Carolina.

Ohio.—"I do not know that any attempts are being made to grow the walnut upon a commercial scale in this State." (*W. Paddock, Ohio Agricultural Experiment Station.*)

Individual trees, however, have been reported as growing and bearing successfully in various parts of the State.

South Carolina.—"Though numerous plantings of the walnut have been made in South Carolina, there are no records of successful croppage. Even the particularly hardy *Juglans sieboldiana* is reported as not hardy enough for the conditions in this State, though *J. nigra* thrives and bears abundantly at an early age in various parts of the State." (*A. G. Shanklin, Clemson College, S. C.*)

From other sources it is learned that the tree appears to be hardy enough in some localities, but that it fails to set fruit.

Tennessee.—"A great many Persian walnut trees in this State are planted in gardens and lawns, but no one, so far as I know, has attempted an orchard of them. Some trees at Hermitage bore the first time about three years ago." (*C. A. Keffer, Tennessee Agricultural Experiment Station.*)

Texas.—"In 1903 we planted several trees of English walnuts at this station, but our results have been entirely negative in character. The trees made a very poor growth, and all but one died inside of four years. This one is still living, but has made only a low, scrubby growth—less than 5 feet—and has not fruited. Judging from our experience, I doubt if they are suited to this vicinity." (*W. S. Hotchkiss, Texas Agricultural Experiment Substation, Troup, Tex.*)

Virginia.—"So far as I am aware, the walnut is not grown in a systematic way in Virginia, though there are scattered seedlings in various parts of the State." (*H. S. Price, Virginia Agricultural Experiment Station.*)

Washington.—"The first walnuts planted in this part of the State were set out in 1896. In this first planting there were 15 trees (this tract has increased until at present there are 175 trees), all seedlings. They have grown vigorously and have been bearing good crops of nuts of variable quality since they were 6 and 7 years old. One of them, for which H. E. Van Deman suggests the name of Chelan, is considered to be a very promising variety. There are now about 30 acres of planted walnuts in this section." (*W. P. Shepard, Lake Chelan, Wash.*)

In the southwestern part of the State, especially in the vicinity of Vancouver, this tree has been growing and fruiting for approximately a quarter of a century. Not only have the trees of the Franquette and Mayette varieties been yielding excellent returns, but several local seedlings have been developed, two or three of which promise to be even better than their parents, the original varieties stated above.

In various parts of New Jersey, Virginia, and West Virginia vigorous, thrifty seedling trees are to be found. Several of these trees produce quite regular crops of nuts of more than passing merit. Most of them, however, yield nuts of inferior quality, and the chief value of the trees lies in the fact that they afford ample proof that the walnut can be grown in these various districts with measurable success. Top-working these trees with wood from hardy varieties of good quality would probably result in converting what is at

present a crop of inferior quality and small value into one of choice quality and highest market price, though it is certain that much better returns would follow the top-working of the native stock in the same or similar localities.

CLIMATIC CONDITIONS REQUIRED IN WALNUT GROWING.

The walnut is quite sensitive to changes in temperature during the early stages of the vegetative period and while the tree is young. It demands a climate that is temperate, relatively mild, and invariable. It is averse to wide ranges of temperature and great humidity, and yet it will endure without damage considerable rigorous winter weather during its dormant period, and even during the annual vegetative periods of its later life it will tolerate climatic variations such as would greatly injure young trees.

This tree suffers less from the severe cold of winter than from the frosts of late spring or early fall. Intense winter cold may split open the trunks and large branches, but serious damage is unlikely where the native walnuts range or in the relatively mild climate of the Pacific Northwest, especially if the stocks used are the native black walnut. The walnut ranges over a considerable area, under varying climatic conditions, but the leading commercial varieties, especially in the United States, grow within a comparatively restricted climatic environment. In that part of France where the highest grade of the commercial product, the Grenoble walnut, is grown, the climate of spring and summer is somewhat cold and the winters rigorous. The mean annual temperature of Tullins in the valley of the Isere, the heart of the nut-producing area of France, is from 45° to 50° F. The rainfall for the district is most abundant during the spring and autumn and averages about 40 inches for the year.

The data in Table I, based on what French writers consider the relationship of climate to successful walnut culture, present a compact view of the climatic conditions in those districts of the United States which produce nuts in commercial quantities, as well as in a few districts where isolated trees or small orchards have borne profitable crops for several years. Considerable of the data given apparently warrants the belief that so far as climate is concerned the area of successful cultivation may be greatly extended; but climatic conditions are not alone essential to success. Quite as much depends upon the careful selection of varieties, and hardiness is only one of the qualities required. The ultimate product, the nut, must be of pleasing outline, regular and uniform in size, with a bright, rich, yellowish-colored shell that is thin and firmly sealed. It must possess a kernel that is crisp, sweet, light colored, and with little or no astringency or bitterness. It should be high flavored, fine grained,

rich, and heavy. The tree must be a vigorous grower and must yield regular and abundant crops. It must be a self-pollinator and not too early. It must carry its blossoms through an extended period and be practically blight resistant.

TABLE I.—*Climatic and other data of important walnut-growing areas.*

Climatic and other data.	France.	California.			Oregon.		Pennsylvania.		New York.	
	Grenoble.	Los Angeles.	San Jose.	Santa Barbara.	Portland.	Albany.	Erie.	York.	Rochester.	Appleton.
Latitude	45° 30′	34° 3′	37° 20′	34° 23′	45° 32′	44° 35′	42° 7′	39° 50′	43° 8′	43° 20′
Elevation.....feet..	1,000	287	95	130	32	224	658	385	498	270
APRIL.										
Temperature (° F.)										
Mean Monthly..	51	60	56	58	51	51	45	50	45	44
Mean Maximum..	68	70	.....	67	60	59	56	62	53	54
Mean Minimum..	39	49	.....	48	42	42	42	39	36	35
Absolute. Maximum	85	99	87	95	89	84	94	94	90	84
Absolute. Minimum	27	38	29	38	28	30	16	16	11	16
Precipitation, inches:										
Mean.....	3	1.1	1.4	1.2	3.2	3.6	2.4	2.6	2.4	2
Annual.....	40	15.6	14.8	16.6	45.6	44.2	39.2	41.9	34.5	32.7
MAY.										
Temperature (° F.):										
Mean Monthly....	58	63	60	60	57	57	57	64	57	55
Mean Maximum..	68	73	.....	69	67	69	65	73	66	65
Mean Minimum..	40	52	.....	50	48	46	49	50	47	44
Absolute. Maximum.	94	103	104	100	99	93	91	95	93	94
Absolute. Minimum	32.2	40	32	40	32	32	31	31	28	26
Precipitation, inches:										
Mean.....	4.25	.5	.6	.4	2.4	2.6	3.6	4.3	3	2.9
JULY.										
Temperature (° F.):										
Mean Monthly....	69	71	67	65	67	67	71	75	71	70
Mean Maximum..	81	83	.....	74	78	82	78	86	80	80
Mean Minimum..	56	59	.....	56	56	51	64	53	62	59
Absolute. Maximum	97	109	100	96	102	103	94	107	99	98
Absolute. Minimum	47	49	41	48	45	39	47	43	45	40
Precipitation, inches:										
Mean.....	4.33	.....	0	0	.6	.3	3.1	4.1	3.1	4.2
AUGUST.										
Temperature (° F.):										
Mean Monthly....	68	72	67	67	66	67	69	73	69	67
Mean Maximum..	83	84	.....	75	77	82	77	84	78	77
Mean Minimum..	59	60	.....	58	55	51	62	61	60	58
Absolute. Maximum	101	106	101	97	97	101	94	102	97	97
Absolute. Minimum	45	50	42	52	43	42	47	42	43	41
Precipitation, inches:										
Mean.....	3.8	.....	.....	0	.7	.4	3.2	4.1	2.9	3.1
SEPTEMBER.										
Temperature (° F.):										
Mean Monthly....	50	70	65	66	61	60	64	66	63	61
Mean Maximum..	55	82	.....	74	71	72	60	77	72	71
Mean Minimum..	51	57	.....	56	51	48	46	55	53	52
Absolute. Maximum	96	108	99	98	93	97	87	95	98	96
Absolute. Minimum	37	44	37	49	36	32	23	20	34	31
Precipitation, inches:										
Mean.....	2.6	.....	.2	.2	1.8	2	3.6	3.8	2.3	3.2

TABLE I.—*Climatic and other data of important walnut-growing areas*—Continued.

Climatic and other data.	France.	California.			Oregon.		Pennsylvania.		New York.	
	Grenoble.	Los Angeles.	San Jose.	Santa Barbara.	Portland.	Albany.	Erie.	York.	Rochester.	Appleton.
OCTOBER.										
Temperature (° F.):										
Mean Monthly	48	64	60	63	54	53	53	53	51	50
Mean Maximum	52	76	.....	72	62	64	48	64	59	60
Mean Minimum	37	52	.....	54	46	43	35	42	42	42
Absolute Maximum	84	102	93	96	83	84	74	88	87	88
Absolute Minimum	37	40	32	47	31	29	26	20	19	24
Precipitation, inches:										
Mean	5.6	.8	.9	.8	3.6	3.4	3.8	3.1	2.8	2.4
DECEMBER.										
Temperature (° F.):										
Mean Monthly	34	56	50	56	42	41	43	43	29	30
Mean Maximum	37	67	.....	68	47	47	39	52	35	36
Mean Minimum	35	46	.....	45	37	37	26	34	22	23
Absolute Maximum	64	89	78	84	65	63	70	77	70	66
Absolute Minimum	65	30	22	32	3	18	−11	10	−11	−2
Precipitation, inches:										
Mean	3	3.3	2.6	3.2	7.4	7.8	3.1	3.4	2.9	2.5
JANUARY.										
Temperature (° F.):										
Mean Monthly	36	54	48	53	39	39	27	33	24	26
Mean Maximum	42	64	.....	64	44	45	34	42	31	32
Mean Minimum	32	44	.....	44	34	34	20	25	18	19
Absolute Maximum	63	87	78	84	62	62	73	68	69	59
Absolute Minimum	−2	30	18	28	−2	10	−15	−1	−12	−2
Precipitation, inches:										
Mean	2	2.8	2.7	3.7	6.6	6.7	3	3.1	3.2	2.6

Table I shows that southern California is remarkably exempt from freezing. Practically all the commercial crop in the United States is produced in this district with its mild, equable climate and deep, fertile soil. Extensive plantings of the Persian walnut are being made in other districts, notably in the Santa Clara, San Joaquin, and Sacramento valleys of California and the Umpqua and Willamette valleys of Oregon. Limited plantings are also being made in several other localities in the Pacific Coast States and in some of the Eastern States—New York, Pennsylvania, New Jersey, Delaware, and Maryland.

Though the Santa Barbara soft-shell walnut is the type of our present commercial output and the one variety most successful in southern California, its prestige may be due to the fact that no other variety has been generally tried in that district. Its early and continued financial success prevented the development of any better variety until the time of the blight invasion a few years ago. Now there is a decided effort to find a variety with the merits of

the soft-shell that shall be blight resistant. It is quite possible that out of this inquiry, which is certain to be an exhaustive one because of the great value of the crop, there will come a new type, or at least one more definite and uniform. While other districts are selecting hardier varieties, southern California, in seeking those that escape the late spring frosts, aims to insure not alone the production of a crop, but also to provide immunity to blight. By a judicious selection of late-vegetating varieties and by top-working upon native stocks, growers may successfully produce choice varieties of Persian walnuts under a much wider range of climate and soil than formerly was possible. Types like the French Franquette, Mayette, and Parisienne appear to be worthy of extended trial in the valleys of northern California, the higher elevations in the interior of the same State, and the western valleys of Oregon and Washington. Among promising varieties worthy of trial in this territory are Eureka, Prolific, Treyve, and Meylan. Certain growers report that Treyve and Meylan are rather shy bearers, which may prove a serious defect in these otherwise good varieties. Types of more or less uncertain parentage, as the Cumberland, Hall, Holden, Milbank, Mount, Nebo, Pomeroy, and Rush, appear to be especially adapted to New York, Pennsylvania, New Jersey, Delaware, and Maryland, and the effort now being made to propagate the more promising of them upon the eastern black walnut bids fair to greatly stimulate the interest in walnut culture in portions of the eastern United States. There is little reason to doubt that several of these varieties may be successfully grown and fruited if proper provision is made for pollination.

To what extent the introduction of grafting upon these hardy stocks will change the practice of growing seedlings from fruit of mediocre merit is as yet uncertain. Very little grafting has been done where only individual trees or small groups about the home grounds are grown from hardy seedlings, as in Michigan, Ohio, Indiana, Illinois, New York, Connecticut, New Jersey, Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Texas, Colorado, and Idaho. In Texas and Maryland considerable interest is being awakened through the work of private experimenters and the experiment stations. The range of country covered by the above list of States shows the possible area over which the walnut may be grown. In most instances only very indifferent success commercially has been attained with seedling trees of the Persian walnut. California and Oregon are exceptions, and here the day of the seedling tree is past save as an effort to obtain a new variety. The orchards of the future will be grafted trees of varieties selected to meet the local climatic environment.

SOIL REQUIREMENTS FOR WALNUT ORCHARDING.

The walnut delights in a deep, moderately cool, moist soil, mellow, alluvial, and rich in humus, but it succeeds well upon clay loams, sandy loams, gravelly loams, or friable clays (such as the so-called shot clays of the Pacific Northwest) when the surface soil is well drained and possesses a liberal humus content and the water table is at a depth of 16 or more feet. For the growth and maintenance of large, long-lived trees, one thing is essential: The soil must be deep, 2 to 3 or more feet, and have a pōrous subsoil from 8 to 12 or more feet deep, and in no instance should hardpan, bedrock, or impervious clay be at a less depth than 16 to 20 feet. The most vigorous and productive walnut orchards in France and California are found upon the deep, cool, well-aerated, alluvial soils of the valleys, and especially upon slight elevations above the main valley floor.

A moderate lime content is a desirable feature of any soil upon which the walnut is to be planted for commercial purposes. Soil that is held to be good for orchard and garden crops may be considered suitable for walnut trees, provided it is sufficiently deep, well-drained as to air and water, and of an elevation sufficient to escape the early autumn and late spring frosts.

A soil composed of small to medium sized gravel mixed with 15 to 40 per cent of fine sand and clay and 1 to 2 per cent of lime makes an excellent host for the walnut tree. The reddish brown alluvial soils of the Pacific coast, rich in iron oxids, when overlying a gravelly, sandy subsoil, are among the best for walnut growing, as they are usually cool and supplied with moisture which thorough tillage and the use of the soil mulch will conserve. These soils are friable and rather coarse grained, fertile, well aerated, deep and retentive, and very responsive to all active tillage.

In the Eastern States, so far as present data show, it may be said that the Persian walnut flourishes on all soils upon which the black walnut is found, and under favorable conditions on some others. In fact, reports from 9 or 10 States say that the walnut will grow satisfactorily upon any good soil if it is deep, sufficiently well drained, aerated, and possesses a low water table. Sandy loams, clay loams, gravelly loams if not too open, and sedimentary deposits are all, separately or mixed, equally suitable for the growth of this tree.

FACTORS IN LOCATING A WALNUT ORCHARD.

LOCATION.

In some respects the problem of locating a walnut orchard is not difficult. The product being extremely hard, compact, and long keeping, it is not essential that railroad facilities be in the immediate

vicinity. Wherever there are passable roads, suitable soils, a fit site, and congenial climate a walnut orchard may be located with quite as much assurance of success as if it were close to a great transportation system or a ready market. If, during the first few years, the grower desires to raise intercrops their importance may be a factor in determining the location. The selection of varieties and the necessity of early marketing affect the problem, since dealers desire the product for the Thanksgiving market. Labor for harvesting has likewise to be carefully considered, especially where large areas are contemplated or where fall rains occur during the period of harvest. Should the walnut harvest come at the same time with other crops it seems desirable that the location should be near a center of population.

SITE.

In a general way it may be said that the walnut requires a site that will insure it protection from excessive heat, cold, wind, drought, and moisture. An ideal site is one that affords protection against the undue stimulating influences of warm days in early spring, the ravages of early autumn frosts, the desiccating effects of drought, the distress of a water-logged subsoil, and the parching heat of a midsummer sun. To what extent it may be possible to secure all of these desirable features in a particular site will depend upon the prevailing climatic and topographic conditions.

European writers consider a western exposure best, and gentle slopes of moderate elevation better than valley floors, higher hills, or plains. Especially should the lower levels of the valleys be avoided if the air is damp and the soil cold and heavy. While the walnut demands a soil with plenty of water, it requires at the same time a dry atmosphere without too much heat. In some instances the fault of a site may be overcome through the selection of suitable varieties. Where an intense summer sun would damage the nuts by burning, partial or entire exemption may be secured through the selection of a variety with an abundance of foliage; where late spring frosts occur injury is reduced to a minimum by selecting late varieties. Only when it is impossible to secure a first-class site should one give a moment's consideration to other than the best varieties, such as by early maturity, prolificness, self-fertility, or a heavy oil content may yield a crop of substantial value.

In the coast valleys of southern California damage from spring and autumn frosts is almost unknown, though occasionally trees growing too late in the autumn have been injured by an unusual cold wave. Cold autumn rains rarely damage the crop and are not to be considered a serious menace. Under such conditions little difficulty will be encountered in selecting a site. Any place that presents a

suitable soil and water supply is acceptable. Low-lying valley lands and river bottoms, so long as their soils are not cold with excess of water, and gently rolling lower benches are equally suitable. Almost universally the more fertile soils of this region occupy the floors of the valleys and the river bottoms. Occasionally, however, the soils of the lower levels are close, heavy, cold, and poorly drained, so that the more suitable site for a walnut grove may be upon the first benches or at the head or margin of the valley floor. In the interior valleys and plains so little has been done with the walnut that anything in the way of specific direction as to site would be mere assumption.

Early and late frosts, hot, dry winds, and intense sunlight are of such importance that each planter must decide his own case according to the facts before him. Protection from winds, excessive heat, and extra-seasonal frosts should be chief considerations in all plantings. As a protection against winds one may select the lee side of a mountain or timber belt; against frosts, an elevated site with good air drainage or a wind-protected vale where orchard heaters may be used in case of need; and against excessive sunlight, trees with dense foliage or nuts with heavy hulls, or both. For the information of the inexperienced it should be said that upon this phase of the subject few facts are at hand, as the possibility of cultivating this tree with commercial success under the conditions that exist in the interior valleys of California has received attention only within the past few years.

In the more northern Pacific coast regions, especially in the valleys of western Oregon, which appear particularly well adapted to the production of a high-grade nut, it is necessary to exercise considerable care in the selection of a site. These valleys have equable climate, congenial soil, and abundant moisture, coupled with sufficient drainage, but occasional frosts in late spring or early autumn damage the crop or even the trees if not properly situated. In some seasons the fall rains retard the maturing crop and increase the staining of nuts from contact with the soil. A judiciously chosen site should provide thorough soil drainage, generous exposure to direct sunlight, and a free circulation of air.

VARIETIES AND TYPES OF WALNUTS.

To-day the leading walnut upon the world's markets is the Grenoble, grown in the valley of the Isere, a river having its source in the foothills of the western Alps in southeastern France. Strictly speaking, the Grenoble nut means the Mayette variety, though the term sometimes includes the Franquette and Parisienne varieties grown in the same section. The leading product of the American

walnut orchards, supplying about one-third of the quantity consumed in the United States, is the Santa Barbara, a soft-shell nut that originated with Joseph Sexton, Goleta, Cal., some 40 years ago and is reputed to be a seedling from a nut imported from Chile. Though this variety (more properly type, if one considers uniformity of product) constitutes something like 90 per cent of the home-grown walnuts marketed in the United States, several other varieties possess high merit. Some of these varieties, notably the home-grown Franquette, enter the American market under their own names, and it is quite probable that several distinctive American varieties will be marketed in a few years. Herein is one of the most promising aspects of walnut growing—the development of the industry beyond a general product. As the apple orchardist during the last decade has passed from a grower of apples in general to a grower of specific varieties, such as the Winesap, Esopus, etc., so the walnut orchardist may anticipate a type of orcharding wherein the grower becomes a specialist, a producer of specific varieties for definite purposes or because of a special environment.

The possibility of producing and marketing a distinct type of nut, having its own particular merits or qualities, will add many attractions to an industry that heretofore has offered no especial incentive to the intelligent person looking for opportunity to develop a special product. Such development of varieties will be a necessary result of the climatic requirements of the northern Pacific coast, quite different from those giving the best results in southern California, and still more so from those yielding partially satisfactory results in the Eastern States. That it is possible to develop varieties particularly adapted to the requirements of these separate districts is no longer considered doubtful by advanced workers in nuciculture. To this end substantial aid is expected from investigations now being conducted by nurserymen and enthusiastic growers with the late-blossoming varieties and hardy stocks in both the Eastern and Pacific Coast States. The California experiment station at Whittier deserves especial credit for arousing interest throughout the State in the effort to develop better varieties, to improve the methods of culture, and to plant grafted trees instead of seedlings.

Of the extended list of varieties of Persian walnuts that have been catalogued, few are of commercial importance in the United States. In this survey of walnut growing, it has been the purpose to consider every variety that appears to possess active or latent possibilities of adaptation and development by which the area of cultivation may be extended. So far as it has been possible to procure home-grown specimens of the several varieties, they have been subjected to critical examination and comparison in order to establish

a uniform and amplified description, such as would enable even a novice to identify typical specimens of varieties of record. It has been impossible within the available time and means to procure specimens of all varieties reported to have been grown in the United States, and in a few instances we were unable to procure sufficient specimens upon which to base a complete description, e. g., of Cosine, Honeydew, Nebo, and Parry. The first, Cosine, is an indifferent variety, reputed to have originated in Oregon from a Chilean nut, and is of historic value only. The other three, and especially Honeydew, are worthy of trial. Nebo is an eastern seedling and may possess little merit for Pacific coast planting. Honeydew is a superior Mayette, so far as outward appearances indicate, and promises to be especially suited to Pacific coast conditions, though it may thrive in the Eastern States when grafted upon the eastern black walnut.

The descriptions offered at this time are necessarily incomplete, since they are based chiefly upon specimens of the crop of 1910, which was a very severe year and an imperfect development of the fruit was generally prevalent. The hope is expressed at this time that originators and growers will advise the Department of Agriculture of the advent of new varieties or of changes in the conduct of established varieties as they are subjected to the influence of new environment, so that deficiencies in the descriptions may be corrected and printed later, with others that may then be given.

Nuts of the cultivated varieties of Persian walnut vary greatly in size, shape, color, and minor characteristics. Those grown in the United States are separated quite readily into varietal groups or types—Bijou, Mayette, Franquette, Chaberte, Santa Barbara, Sorrento, etc.—and for the purpose of facilitating classification 20 such types have been defined. So far as known this is more complete than any previous grouping of the walnut. Classification requirements are apparently best met by the French system, comprising five leading divisions as determined by (1) region, (2) location of growth, (3) precocity, (4) thickness of shell, and (5) use. Of the various groups, the following may interest American planters:[1]

Varieties for lower level lands and plains: Chaberte, Common, Parisienne.

Varieties for hillsides and bench lands: Common, Cornes,[2] Chaberte, Fertile, Franquette, Hardshell, Marbots,[2] Mayette, Saint John, Vourey.

[1] Arthaud-Berthet, J. Culture du noyer en France. Annales de l'Institut National Agronomique, sér. 2, t. 2, 1903, pp. 19–144, 7 pls.

[2] Commercial types rather than specific varieties.

Varieties for dessert: Cornes, Fertile, Figeac, Franquette, Gauteron, Marbots, Mayette, Meylan, Nave, Parisienne, Thinshell, Vourey.

Varieties for confections: Candelon, Careme, Chaberte, Common, Small Round.

Varieties for oil: Bijou, Candelon, Careme, Chaberte, Cluster, Common, Double Kernel, Hardshell, Noisette, Saint John.

CLASSIFICATION AND DESCRIPTION OF VARIETIES.

The tentative scheme of classification here given is offered with a view to facilitate the study of varieties and types of the walnut grown in the United States, and may be of service in the effort to extend the area of successful walnut culture. The basis of the scheme is the structural resemblance of the nuts, an arbitrary grouping, only incidental consideration being given to botanical relationships; but this classification does, in effect, group varieties closely related, since the form and structure generally indicate varietal peculiarities within the several groups. In the future it may be possible to classify the varieties according to a more exact and natural scheme, but with the data available it appears impossible at present.

Names in italic indicate varieties which are types of their respective groups. No type is designated where, so far as ascertained, none exists in American orchards. The word "type" after the name implies that the variety described is the standard of that group. The name usually agrees with the type name, though in the case of Persian Long, Marbot, Sorrento, and Cahor there are no type varieties growing in the United States, so far as known.

SCHEME OF CLASSIFICATION.

BIJOU: A'Bijou, Acme, Alpine, Barnes, *Bijou*, Calavette, Glady, Hall, Klondike, Mammoth, Payou, Peerless, Willson.

CAHOR: Chelan, Ward.

BRANTOME: Hays.

CHABERTE: *Chaberte*, Drew,[1] Papershell.

CHINESE: *Changli*.

CLUSTER: *Cluster*, Concord, Fertile (Gillet seedling).

COMMON: Weaver.

FERTILE: *Fertile*, Late Fertile, Mammoth Fertile.

FRANQUETTE: Franmay, *Franquette*, Mayquette, Vourey[2] (short).

HYBRID: Barthere, Paradox, Royal, Vilmorin.

LALANDE: Derby.

MAYETTE: Bennett, Chicoette,[3] Columbus,[3] Fertile (Gillet seedling), Grand Noblesse, Honeydew, *Mayette*, Mayette Blanche.

[1] Based upon illustration and description by Arthaud-Berthet, but not conforming to the type illustrated in Plate VI.

[2] Specimens of this variety sent in by the late Felix Gillet do not conform to the French type as described and illustrated by Lesourd.

[3] Doubtful.

MARBOT: Holden, Mount, Pomeroy.[1]

MEYLAN: *Meylan.*

MISSION: *Mission.*

MONTIGNAC:[2] Lea.

NAVE: Ellwood.

PARISIENNE: Milbank, Nebo, *Parisienne,* Rush, Sinclair, Treyve.

PERSIAN LONG: Chase (2), Eureka, Hale, Kaghazi (long), Keesling, Prince, Prolific, Stocktonian.

SANTA BARBARA: Chase (1), Ford, Journeay, Lane, Neff, Placentia, *Santa Barbara,* Santa Rosa, Sexton, Teague.

SORRENTO: Dean, Hubbard.

NOT CLASSIFIED.—The writer has been unable to see either specimens or written descriptions of the following varieties; hence, no attempt is made to group them: Ford's Mammoth, Hightstown, Longbeaked, Mobart, Parry, Poorman, Thinshelled, Volga, Weeping.

DESCRIPTIVE LIST OF VARIETIES.

In the following descriptive list of varieties of the Persian walnut the statements as to size are made by comparing the American-grown nuts with the average French Mayette. Upon this basis Cumberland and Rush are approximately typical of a medium-sized nut.

Technical terms used are chiefly from European writers and some have been adapted from modern systematic botany. For convenient reference a few are here defined:

Appressed. Ribs of the sutures not above the general surface of the shell.

Convolutions. The waving or folded rolls of the margins of the kernel.

Diaphragm. The thin, woody, membranous tissue that more or less distinctly separates the halves of the kernel.

Equator. An estimated horizontal region midway between the apex and the base, though in some instances, when considering the location of the pits at the sutures, it is deemed to be somewhat above or below a median line.

Flange. The face of the suture, varying in width with the different varieties.

Longitudinal lines. The more or less pronounced lines which pass from base to apex over the shell midway (or nearly so) between the sutures.

Mucronate. Having a suture tipped with a short, sharp, thin point.

Pellicle. The thin membrane that covers the kernel. It is the seat of the astringent and bitter principles that mark many of the American-grown walnuts.

Sutures. The more or less ribbed lines along which the two halves of the shell unite.

A'Bijou.

A name used by John Rock to designate a seedling of Bijou quite similar in form and size to the variety herein described as Klondike (p. 44), but having a much richer yellowish shell.

[1] The two lots of Pomeroy walnuts received for comparison differed so widely in general character that it is impossible to assign this variety satisfactorily to any one group. Nuts from one of the parent trees, crop of 1910, resemble the Common nut of France, while the nuts from seedling trees of the parent Pomeroy trees resemble very closely the Figeac type. Until a more extended study of this variety is made it must remain unclassified, though Dr. Morris has stated that in his opinion it is a Marbot.

[2] After Lesourd.

Acme.

A large nut of the Bijou type, similar to the Willson; originated in the same section and at about the same time. Said by the introducer to be blight resistant.

Ailanthus Leaved.[1]

Probably a synonym of *Juglans sieboldiana.*

Alexis.

A seedling originating on the property of Alexander Smith, Cecil County, Md. The tree is very vigorous and productive. The nut is reputed to be large and good. Exhibited at the meeting of the Northern Nut Growers' Association, Lancaster, Pa., 1912.

Alpine.

Bijou type; large; broadly oblong, angular and slightly tapering toward the base; base obtuse and rounded; apex obtuse with short mucronate point; sutures appressed toward the base and only slightly ribbed toward the apex, pitted at the equator; flange very firmly sealed; shell grayish yellow, roughened with numerous deep, irregular, variable pits and protuberances, usually two or more longitudinal lines well defined. *Origin:* France; specimens grown by Felix Gillet, crop of 1904.

Lelong, in his treatise entitled "California Walnut Industry," published in 1896, writing of this variety, says: "A new and very large variety that originated not long ago in the Alps Mountains of France. Next to the Mammoth it is the largest walnut grown on my place. Though the shell is rough, it is thin, and the meat sweet and filling well the shell."

Andrus.

A seedling originating with F. P. Andrus in Michigan. It is reputed to be a hardy tree on its own roots in that State.

Ash Leaved.

Synonym of Cutleaf.

Barnes.

Bijou type, modified; size above medium; obovate to roundish or occasionally nearly oblong; strongly four-angled, many specimens will stand quite erect upon apex; base obtuse to acute; apex obtuse-truncate, small mucronate tip usually depressed; sutures appressed, more or less depressed toward the base, usually two to four rather large, deep, widely separated and commonly oblique pits at the equator; flange narrow or even very narrow, firmly sealed; shell rather thick, grayish brown, sometimes slightly mottled, moderately smooth, though a few deep depressions and a few pronounced protuberances are present, veining ample, longitudinal lines usually well defined; diaphragm firmly shouldered, rather strong, and inclined to be persistent; kernel full, convolutions even, quite regular; pellicle brownish with slightly darker veins which are broad but not numerous, astringent; flesh firm, crisp, rather dry, fine grain; flavor sweet, pleasant; quality fair to good. *Origin:* Seedling trees growing upon the grounds of Theodore Barnes, in Washington, D. C.; first called to public attention in an exhibit at the Convention of Northern Nut Growers, Ithaca, N. Y., 1911, by T. P. Littlepage.

Barthere.[2]

A French variety introduced into the United States in 1871. Of this variety Mr. Gillet, the introducer, says: "A singularly shaped nut, elongated, broad at the center and tapering at both ends; the shell is harder than that of other varieties."

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[1] Georgia Horticultural Society, 1900.

[2] Catalogue, Barren Hill Nurseries, 1887–88.

Bennett.

A variety reputed to have been produced from a nut purchased in New York City in 1874 by James L. Bennett, and grown upon his property at Unionville, Orange Co., N. Y.

Bijou.

Type; very large; oblong to more or less obovate and angular; base obtuse; apex obtuse to depressed, mucronate tipped; sutures appressed or even depressed especially toward the base, pitted at the equator and toward the apex, frequently pits form a continuous line over half the length of the suture; flange narrow, usually firmly sealed; shell brown, thickened by ridges and irregular protuberances, and strongly roughened by numerous pits and depressions, longitudinal lines occasionally well defined; diaphragm weak shouldered, thin, and scarcely persistent; kernel quite full, rather plump, convolutions moderate, very irregular; pellicle brownish yellow, dull, astringent; veins rarely noticeable; flesh moderately oily; flavor sweet, mild; quality good. *Origin:* Europe; specimens grown by Ely I. Hutchinson, crop of 1910. (See Pl. III.)

Burbank.

Synonym of Santa Rosa.

Calavette.

Bijou type; originated with E. M. Price, Westpoint, Cal. It is a cross between Bijou and Fertile. It is not recommended for sections in which late frosts occur, though it originated at an elevation of 3,000 feet in the Sierra Nevada Mountains.

California Papershell.

Originated by Felix Gillet from a nut borne on a grafted Chaberte tree. It is, therefore, a second generation Chaberte. The nut is only medium in size; shell very thin and almost white; kernel full fleshed, exceedingly sweet and nutty.[1]

Chaberte.

Type; medium; oblong; base obtuse; apex obtuse, mucronate tipped; sutures appressed to very slightly ribbed, usually pitted at the equator; flange variable, usually broad, very firmly sealed; shell brownish, thick, slightly roughened with a few depressions and protuberances, longitudinal lines well defined; diaphragm firmly shouldered, thin, but somewhat persistent; kernel full, fairly plump, convolutions moderate, variable; pellicle brownish yellow, dull; scarcely astringent; veins very noticeable; flesh oily, rich; flavor mild, sweet; quality very good. *Origin:* France; specimens grown by Ely I. Hutchinson, crop of 1910 (Pl. VI).

A variety held to be of very general merit. In France it is considered a very suitable variety to plant on both foothills and valley floors; it is valued in Europe as rich in oil and for confections. It is rather late in vegetating in the spring. An objection to the walnut for confectioners' use is that the kernels are too large, but our planters may find it worth while to ascertain if the Chaberte or a similar nut can be advantageously grown in this country.

Changli.

(S. P. I. No. 17943.) Chinese type; large; roundish oblate; base obtuse truncate; apex obtuse to retuse truncate without point or tip; sutures appressed toward the base, slightly ribbed, broad and rounded above, more or less pitted at the equator; flange very firmly sealed; shell brownish yellow, somewhat roughened by depressions, usually slight, with few

[1] Lelong, B. M. California Walnut Industry. 1895–96.

pits, longitudinal lines, usually light and rather inconspicuous, though rarely altogether absent. (See Pl. II.) *Origin:* China. Specimens collected in the vicinity of Changli, Chihli Province, China, by F. N. Meyer.

Mr. Meyer, in Bulletin 204, Bureau of Plant Industry, entitled "Agricultural Explorations in the Fruit and Nut Orchards of China," writing of this variety together with others produced in the same locality, remarks: "In the vicinity of Changli, Chihli Province, there are some walnut orchards in which the trees vary to a remarkable degree. Some produce small, hard-shelled nuts of poor flavor, while others bear fine, large nuts, with a really fine flavor, and having shells so thin that they can be cracked with the fingers like a peanut. Between these extremes one finds many gradations in hardness of shell, size, and flavor. It is very likely that some kinds of these Chinese nuts may prove to be much hardier than our present Persian strain of walnuts and in all probability they will thrive especially well in certain sections of the southern Rocky Mountain region."

This Chinese type of walnut Mr. Meyer has designated as *Juglans regia sinensis*. The type is admirably illustrated in the above variety, to which, though reported by number, the writer has given the name Changli, to designate its source. As already indicated, the nuts are large, flattened at the ends, inclined to smoothness and full roundness, with sutures marked by peculiar broad and smooth, rounded ribs. The age of the specimens prevented determination of the value of the kernel at the time of describing the nut, but on the strength of Mr. Meyer's statement that the fine large nuts possess a really fine flavor, steps have been taken to import wood of this variety and others from the same district.

Chase (1).

Santa Barbara type, closely resembling the More form; large; broadly oblong and angular; base rounded, occasionally acute; apex obtuse or acute and strongly pointed; sutures usually strongly ribbed, rarely pitted at the equator; flange narrow, very firmly sealed; shell thin, grayish brown, roughened by various irregular depressions, longitudinal lines not infrequent; diaphragm almost weakly shouldered, thin, yielding, rarely persistent; kernel full, rather plump, convolutions moderate, even; pellicle rather dark, glossy, astringent; veins dark and rather well defined; flesh rather coarse, oily, rich; quality fair. *Origin:* A seedling from nuts imported from France by Felix Gillet and planted by Mr. Van Vorce near Whittier, Cal., in 1886; specimens supplied by A. R. Rideout, crop of 1910 (Pls. VI and X).

Chase (2).

Persian Long type; this type differs from the preceding in that the nuts are more narrowly oblong, smoother, and more regular, with appressed or very slightly ribbed sutures that are usually less firmly sealed; specimens supplied by A. R. Rideout, crop of 1910 (Pl. X).

This variety is indorsed by the University of California as worthy of extended trial by those in search of blight-resistant varieties.[1] The variety does not appear to be firmly fixed as yet, or else more than one form is being propagated.

Chelan.

Cahor type; medium to slightly above; oblong; base obtuse to slightly rounded; apex obtuse to acute with slight point; sutures very moderately ribbed, equatorial pits variable, often absent; flange very thin, firmly

[1] Bulletin 203, California Agricultural Experiment Station.

sealed; shell very thin but rather firm, yellowish or grayish brown, roughened with numerous irregular depressions and furrows; diaphragm weakly shouldered, thin, and scarcely persistent; kernel full, rather plump, convolutions moderate and variable; pellicle dark yellowish brown, semiglossy, very astringent; veining inconspicuous; flesh crisp, rather dry; flavor sweet, mild; quality fair. *Origin:* Chance seedling in Springdale Orchards, Lakeside, Wash., 1899; specimens grown by D. H. Hulseman, crop of 1910 (Pl. V).

This variety is a promising one for planting in districts where climate renders the cultivation of the Persian walnut doubtful. It ought also to be of value for breeding in the Eastern States.

Chicoette.

Mayette type. Attention was first called to this variety by Mr. F. G. Peterson, head gardener at the Bidwell ranch at Chico, Cal., 1910. The tree was purchased among others and planted on the estate some years ago. E. M. Price writes of it as follows: "It is a prolific bearer; blossoms about the first of June and ripens its fruit in the early fall. It is a choice white-meated, well-flavored nut, resembling Mayette in form, and I am inclined to class it as a sport of the same."

Should this nut prove to be all that is described and be white meated under the extreme heat that frequently prevails in the region of Chico, it will be a valuable acquisition.

Cluster.

Type: Above medium to large; broadly oblong to oblong ovate; base rounded to obtuse; apex acute to acuminate, mucronate tipped; sutures appressed; flange narrow, very firmly sealed; shell bright yellow, generally smooth, though covered with a network of fine depressed veins, moderately thick, longitudinal lines well defined though not conspicuous; diaphragm strongly shouldered and quite persistent, though only of moderate thickness. *Origin:* Belgium; introduced into the United States by Felix Gillet; specimens grown upon a grafted tree by Mr. Gillet, crop of 1891 (Pl. VIII).

Mr. Gillet says, "The fruits of this variety are of average size and grow in clusters of 8 to 15." The distinctive form and general surface character of this nut are attractive. If upon further examination the quality should prove to rate high, it would be entitled to extended tests in the north Pacific coast region and in the more favorable sections of the Eastern States.

Columbus.

Mayette type. Originated with Felix Gillet from the nut of a second-generation Mayette. The nut is very large, exceedingly pretty, roundish, with smooth, light-colored shell, and kernel of first quality. Named "Columbus" in honor of the World's Fair at Chicago, 1893.[1]

Common.

Synonym of Mission and of Fertile.

Concord.

Cluster type; above medium; oblong to roundish oblong; base rounded; apex rounded to obtuse, mucronate tipped; sutures appressed or very slightly ribbed, rarely pitted at the equator; flange moderate to narrow, firmly sealed; shell moderately thin, usually grayish brown, smooth, with few furrows and pits, longitudinal lines generally indistinct; diaphragm weakly shouldered but strong and occasionally persistent; kernel full, convolutions regular, even, moderate; pellicle of a brownish cast, rather

[1] Lelong, B. M. California Walnut Industry. 1895–96.

glossy, mildly astringent, veins inconspicuous; flesh crisp, slightly oily, rich; flavor sweet; quality fair to good. *Origin:* Chance seedling from an importation of Cluster nuts by Felix Gillet; first grown by J. M. Westcott, of Concord, Cal.; specimens grown by Ely I. Hutchinson, crop of 1910 (Pl. V).

A variety worthy of extended trial. The tree is a strong, robust grower, possessed of ample, large, smooth, light-green leaves. It yields under good care a crop somewhat above the average in quantity. The nut is of attractive form and size, though the color is a trifle gray for the connoisseur. It should be an excellent parent for breeding blight-immune and late frost-proof varieties. It is recommended for trial by the University of California as blight resistant.[1]

Cosine.

A variety of no special merit, but of some historic interest as being the first Chilean seedling produced in Oregon.

Cumberland.

Parisienne type; medium to slightly above; roundish ovate; base obtuse to slightly rounded; apex obtuse to acute with mucronate point; sutures lightly ribbed or even somewhat appressed toward the base, pitted at the equator; flange narrow, firmly sealed; shell thin, but roughened with numerous irregular and variable depressions, central longitudinal lines usually well defined; diaphragm weak shouldered, thin, and rarely persistent; kernel full, plump, convolutions large, irregular, and variable; pellicle brownish yellow, dull, astringent; veins inconspicuous; flesh oily, rather rich; flavor sweet; quality fair. *Origin*: A nut brought from Germany in 1868 and planted in Carlisle, Pa., by Mrs. John Meek, produced the parent tree of this variety; specimens supplied by Miss Sarah E. Motts, crop of 1910 (Pls. VI and XI).

A variety that merits general trial throughout the walnut-growing areas of the Eastern States. It is distinctly in advance of the average seedling Persian walnut of this region.

Cutleaf.

Fertile type as to form; small, oblong to narrowly oblong; base rounded; apex obtuse to acute with mucronate tip or quite strong point; sutures slightly ribbed, pitted at the equator; flange broad, very firmly sealed; shell rather thick, smooth to slightly roughened by various furrows and occasional depressions, longitudinal lines distinct; diaphragm strongly shouldered and somewhat persistent; kernel full, plump; convolutions variable, though usually pronounced. *Origin:* Europe; specimens grown by the California Nursery Co., crop of 1891 (Pl. VIII).

This is a variety for the amateur, but of no promise for commerce. It is thus described by Felix Gillet;[2] "The foliage of this variety is so delicate, so finely cut up, that it makes a most graceful ornamental tree, worthy to be planted conspicuously in the garden or front yard. The nut, besides, is exceedingly pretty, of fair size, round, with a very smooth shell and sweet kernel. The tree is claimed to be an abundant bearer."

Dean.

Sorrento type, modified; medium to above medium; oblong to broadly oblong and not infrequently more or less obovate; base obtuse to more or less acute; apex obtuse, or even retuse to occasionally acute, with mucronate tip or sometimes a quite strong point; sutures usually appressed, though occasionally moderately ribbed; equatorial pits usually present; flange

[1] Bulletin 203, California Agricultural Experiment Station.

[2] Lelong, B. M. California Walnut Industry. 1895–96.

moderately broad, firmly sealed; shell rather thick, quite smooth, even and usually regular, grayish brown, splotched; diaphragm rather weakly shouldered, but inclined to toughness and usually persistent; kernel full, plump, with even, regular, moderate convolutions; pellicle dark, rich, golden brown, dull, scarcely astringent; flesh very oily, only moderately sweet; flavor mild or indifferent; quality fair. *Origin:* The parent tree of this variety was produced from a nut purchased by O. Z. Dean from the local grocery store at Shellman, Ga., in 1878 or 1879, and planted where the tree now stands. The bole is 10 to 12 inches in diameter, the foliage heavy, and the tree has been bearing 15 or 20 years. Z. P. Dean states that the crop varies from 25 to 75 pounds; specimen by courtesy of Z. P. Dean, crop of 1911 (Pl. X).

Derby.

Lalande type modified; medium; oblong to broadly oblong, or sometimes even slightly obovate; base obtuse to occasionally almost acutely rounded; apex almost truncate to obtuse with short, strong point usually double-tipped; sutures appressed over lower half, moderately ribbed over upper half, irregularly pitted toward or above the equator; flange very broad and firmly sealed; shell thick, strong, grayish, moderately smooth, though strongly marked with veinings, longitudinal lines pronounced, not infrequently all six fully defined; diaphragm heavy shouldered, strong, and persistent; kernel full but not plump; convolutions moderate and variable; pellicle beautiful, rich, brownish yellow, dull, slightly astringent, veins scarcely noticeable; flesh crisp, fine grain, oily; flavor indifferent, moderately sweet; quality fair. *Origin:* A seedling with S. H. Derby, Woodside, Del.; specimens from Mr. Derby, crop of 1911 (Pl. IX).

Drew.

Chaberte type; small; rounded to more or less obovate; base rounded with projecting tip of extended sutures; apex obtuse to retuse-truncate, with mucronate tip; sutures moderately ribbed, usually somewhat pitted at the equator and toward the base; flange rather broad, very firmly sealed; shell rather thin, yellowish, somewhat roughened by numerous slight depressions, pits, and protuberances; longitudinal lines usually present and well defined; diaphragm thick, heavy, firmly shouldered, and persistent; kernel full with ample and variable convolutions; pellicle dull to semiglossy, light brown, scarcely or slightly astringent; veins inconspicuous or occasionally a few dark ones; flesh rather crisp, oily; flavor rather sweet; quality fair. *Origin:* Chance seedling from a nut planted by Andrew Corsa, Milford, Del., in 1875; specimens grown by W. P. Corsa, crop of 1894.

J. L. Budd, in the American Horticultural Manual, part 2, 1903, states that the kernel of this variety is thick, plump, and easily extracted, the meat yellowish, and the quality very good. It was disseminated to a small extent, particularly in Pennsylvania. The original tree was a shy bearer and after producing a few crops was cut down. Efforts to obtain data in Pennsylvania have failed to yield any definite information.

Dwarf Prolific.

Synonym of Fertile.

Ellwood.

Nave type; medium to above medium; narrowly oblong to elliptical; base obtuse to acute; apex acute, though sometimes obtuse, with strong point; sutures moderately ribbed, pits variable, usually clustered toward the base; flange usually medium, though variable, well sealed; shell thin,

bright yellow, moderately smooth, amply veined; longitudinal lines variable though usually present; diaphragm weakly shouldered, thin, and rarely persistent; kernel quite full though not plump, convolutions medium, variable, and broken; pellicle golden yellow to brownish, very mildly astringent, veins few, somewhat darker; flesh firm, crisp; flavor nutty, moderately sweet; quality fair. *Origin:* Chance seedling at the home of Ellwood Cooper, near Santa Barbara, Cal.; specimens from Mr. Cooper, crop of 1911 (Pl. XI).

Mr. Cooper looks with favor upon this type of nut, but the writer is of opinion that the elongated, elliptical, pecan-shaped walnut is not the best form for a permanent type of dessert nut.

Eureka.

Persian Long type; large, somewhat angular, rather narrowly oblong, lower half frequently tapering to base; base rounded or somewhat angular, acute, though occasionally somewhat obtuse; apex obtuse or acute, usually strongly pointed; sutures only moderately ribbed, rarely pitted at the equator; flange moderate or rather broad, very firmly sealed; shell rather thick, grayish (possibly due to bleaching), slightly roughened by irregular shallow depressions; longitudinal lines usually present and well defined; diaphragm rather firmly shouldered, thin, yielding, rarely persistent; kernel full, plump, convolutions moderate, variable, and broken; pellicle light yellow, glossy, astringent, veins usually inconspicuous; flesh rather coarse, rich, oily; flavor insipid; quality fair. *Origin:* A seedling on the Stone property, Fullerton, Cal., from a nut taken from the original Kaghazi trees on the Meak property at Haywards; first propagated by grafting in 1905; specimens grown by E. G. Ware, crop of 1910 (Pl. VII).

This variety is one of half a dozen recommended by the University of California for trial in the search for blight-immune varieties.[1] While not of high quality it may serve as parent to a variety of much greater merit if sufficiently blight resistant. The form of the nut is against it, at least for dessert purposes. Long, narrow, angular walnuts are not accepted upon the leading markets as desirable forms. The accredited form is the Grenoble, Mayette, or Parisienne, though the best grades of the Chinese would probably be equally acceptable. At the present time there is little discrimination by buyers against nuts on account of form, but as soon as the crop is produced to such an extent that markets are sought, form will become an important factor in determining the price. The Eureka is highly recommended by some leading growers of southern California as a very desirable variety, and promises to be one of the leaders in commercial plantings.

Specimens of this variety grown by Dr. W. W. Fitzgerald, of Stockton, Cal., crop of 1911, rate considerably higher in quality than those examined and described in 1910. Of the latter it may be said that the flavor is mild and sweet and the quality good, while all other essential features answer the description.

Favorite.

Approaching Franquette type; above medium to large; usually oblong though frequently unilateral, while smaller ones are sometimes rounded; base obtuse, rounded, and frequently oblique; apex obtuse with short and rather stout mucronate tip; sutures usually quite strongly ribbed, equatorial pits negligible, though pits are generally present along the surface, especially along the lower half; flange very broad and very firmly sealed;

[1] Bulletin 203, California Agricultural Experiment Station.

shell dark grayish brown, thick, roughened with various depressions and protuberances; longitudinal lines occasionally well defined though usually broken, irregular, and negligible; diaphragm strongly shouldered, heavy, and persistent; kernel full, plump, moderate though variable convolutions; pellicle light to velvety brown, glossy to semiglossy, scarcely astringent, veins ample and dark; flesh crisp, moderately oily, and rather starchy; flavor mild; quality only fair. *Origin:* Sport of Serotina; seedling grown by Thomas R. Smith, Westport, Cal.; specimens supplied by E. M. Price, crop of 1910.

Speaking of this variety, Mr. Price says: "It blossoms early even for this altitude, 3,000 feet. It is an alternate bearer; that is, yields a full crop one year and a sparse one the next. It is immune to blight and sun scald."

Fertile.

Type, medium; rather narrowly oblong, more or less tapering to the rounded base; apex obtuse, mucronate tipped; sutures slightly ribbed, scarcely pitted at the equator; flange variable, narrow and moderately firmly sealed; shell thick, strong, grayish brown, rather smooth; longitudinal lines not infrequent and quite well defined; diaphragm quite firmly shouldered but yielding and usually not persistent; kernel full, plump, convolutions very moderate and variable; pellicle light yellowish, generally dull, though occasionally partially glossy, astringent, veins inconspicuous; flesh only moderately oily; flavor mild; quality fair. *Origin:* France, about 1838; specimens grown by Ely I. Hutchinson, crop of 1910 (Pls. VI and X).

Fertile (cluster type).[1]

A variety of Fertile said to be very fine. Originated by Felix Gillet. Nut large, oblong, smooth surface, perfect soft-shell; kernel fine and sweet. Produced in clusters.

Fertile (first generation).[1]

Introduced into California by Felix Gillet in the winter of 1870–71. The first trees of this variety to produce fruit in the State grew at Barren Hill Nurseries at an altitude of 2,600 feet. The variety originated in France in 1828 and received its name because it bore its first fruit at 2 years of age and is of surprising fertility. The nut is small, thin shelled, and very sweet. Nuts from trees of this character produce "second-generation" trees.

Fertile (second and third generation).[1]

These seedlings are of variable merit. Such title distinctions are of historical value as they call attention to the labored efforts of the past to establish and fix types and varieties by seedling propagation.

Fertile (Mayette shaped).[2]

Originated with Felix Gillet about 1870. It is a large nut sitting on its end like a Mayette, hence its name. It has a full-fleshed kernel of first quality and is a heavy bearer.

Ford.

Santa Barbara type; large, angular, broadly oblong; base obliquely obtuse to rounded; apex obtuse to acute with strong point; sutures strongly ribbed, occasionally pitted at the equator; flange usually broad, frequently imperfectly sealed; shell moderately thin, grayish, roughened by numerous slight and irregular depressions, longitudinal lines infrequent, though occasionally well defined; diaphragm moderately shouldered, thin, yielding,

[1] Thus described by Lelong in his treatise entitled "California Walnut Industry," under the varietal name "Præparturiens" [Præparturiens].

[2] Thus described by Lelong in "California Walnut Industry."

rarely persistent; kernel moderately full, rather plump, convolutions moderate, very variable; pellicle rather dark, generally dull, slightly astringent; flesh rather dry, starchy; flavor mildly sweet; quality fair. *Origin:* Grown by G. W. Ford, Santa Ana, Cal., from nuts procured in San Francisco, planted in the spring of 1880; specimens grown by Mr. Ford; crop of 1910 (Pl. VII).

Ford's Eureka.

A name applied by Mr. Ford to seedlings of the second generation of the variety Ford, which have been distributed as seedlings. It is quite likely that this variety will disappear, yielding the name Eureka to the variety described under that name.

Ford's Improved Softshell.

Synonym of Ford.

Ford's Mammoth.

Reported by name only by H. M. Williamson in report of the Oregon Board of Horticulture, 1906.

Franmay.[1]

Franquette type; large; oblong ovate; base obtuse, ridged or spurred; apex acute, strongly pointed; sutures strongly ribbed over upper two-thirds, elevated and flattened toward the base, large open pits at the equator; flange broad, well sealed; shell rich yellow, rather thin, moderately roughened with deep lines, irregular depressions, and usually slight and variable protuberances, longitudinal lines well defined, and frequently deep; diaphragm weakly shouldered though rather strong and inclined to be persistent; kernel full, irregular, convolutions pronounced and variable; pellicle with yellowish brown tinge, glossy, astringent, veins inconspicuous; flesh rather crisp, starchy, moderately oily; flavor moderately sweet, mild; quality good. *Origin:* Grown from a nut produced by cross-fertilization between Franquette and Mayette, by Tribble Bros., Elk Grove, Cal., crop of 1911 (Pl. XI).

Franquette.

Type Vrooman; large; oblong, with tapered upper half, though in section on plane of valves, ovate; base rounded; apex acute, strongly pointed; sutures strongly ribbed, pitted at the equator; flange narrow, firmly sealed; shell thin, yellowish, frequently with reddish tinge, moderately smooth though roughened along the sutures, longitudinal lines usually present and definite; diaphragm weak shouldered, thin and rarely persistent; kernel full, moderately plump, convolutions pronounced, irregular; pellicle rich, light yellow, usually glossy, moderately astringent, veins well defined; flesh starchy, oily, rich; flavor slightly sweet, mild; quality very good. *Origin:* France; specimens grown by Vrooman estate, crop of 1910 (Pl. V).

This variety and type are highly recommended and have been extensively planted on the north Pacific coast in recent years, not only as grafted trees but as seedlings. The reasons advanced for the use of seedlings were as follows: (1) There were not enough grafted trees to supply the demand; (2) the nuts offered for sale for planting being grown in a large orchard of grafted trees of this variety alone (except for a few Chaberte trees that were grown in one corner of the orchard tract), it was held that a very large percentage of the trees would produce fruit true to name; (3) in order to plant an orchard of grafted trees one must defer the planting of any considerable acreage for an indefinite time, as this method of propagation is difficult and yields only a small percentage of marketable

[1] Tentative name, subject to the approval of the originator.

trees each year; (4) to incur the increased cost of grafted trees over that of nuts and seedling trees was not advisable under the circumstances; (5) the small loss occasioned by planting some seedling trees of indifferent value would be counterbalanced by the difference in cost and the increased value of the property due to immediate planting, which could be done with either nuts or seedling trees, as there were plenty of these upon the market. Whether results will confirm these views remains to be seen with the fruiting of the tracts. The eagerness of planters to set out walnuts at that time was no doubt instrumental in causing one or two points of moment to be overlooked, namely, that grafted trees usually fruit earlier than seedlings, and that the stock is an important factor which is entirely ignored in the planting of seedlings. At the same time insufficient weight is accorded the fact that seedling trees yield at best a variable product which is not true to name. With whatever variety or section concerned, the day of making a walnut orchard with nuts or seedling trees is past. Hereafter, not alone type or variety but stock and scion as well must be given full consideration, and this necessarily implies grafted or budded trees.

While the form of Franquette is not as acceptable to connoisseurs as that of Mayette, the uniform size, rich golden-yellow color, and peculiar rustic appearance, together with the mild-flavored fat kernel, will do much to make it a popular variety. Especially does this statement apply to the Oregon-grown Franquette, which is generally conceded to be somewhat sweeter than other American-grown specimens of this variety. The one serious fault of the Franquette is that the trees yield to the attack of the blight in several districts, though it is recommended for trial by the University of California.[1]

Garden Grove Prolific.

Synonym of Prolific.

Geit.

Parisienne type; above medium to large; roundish oblong; base obtuse to obliquely truncate; apex rounded with mucronate tip; sutures appressed over lower half, slightly to moderately ribbed over upper half, usually one or two pronounced pits at the equator; flange broad, very firmly sealed; shell thick, hard, moderately to quite smooth, longitudinal lines rarely defined; diaphragm strongly shouldered and persistent; kernel quite full, convolutions variable, broken, uneven; pellicle dark brown, astringent, semiglossy, veins inconspicuous; flesh rather crisp, rich, oily; flavor indifferent; quality fair. *Origin:* A seedling tree in Lancaster County, Pa.; first brought to public attention at the Northern Nut Growers' Convention, Ithaca, N. Y., December, 1911, by J. G. Rush.

For planting in the eastern United States this variety is not comparable with Cumberland, Holden, Mount, Nebo, Pomeroy, or Rush.

Glady.

Bijou type; very large; oblong, angular, sometimes tapering to the base; base rounded though occasionally truncate; apex obtuse or slightly acute with mucronate tip; sutures appressed, more or less depressed toward the base; flange usually narrow and firmly sealed; shell moderately thick, brownish yellow, very rough, and strongly marked with veins; diaphragm rather thick, though not strongly shouldered, usually persistent; kernel not full, somewhat shriveled, convolutions moderate and rather regular;

[1] Bulletin 203, California Agricultural Experiment Station.

pellicle light, glossy, very astringent; veins dark and conspicuous, though not numerous; flesh dry, tough; flavor mild, moderately sweet; quality fair. Specimens grown by Ferd Groner; crop of 1910 (Pl. XI).

Grand Noblesse.

Round Mayette type; above medium to large; roundish oblong to somewhat obovate; base obtuse truncate; apex obtuse with mucronate tip; sutures appressed to slightly ribbed; pits at the equator present and pronounced or absent; flange varying from moderate to broad and quite firmly sealed; shell rather thin, usually smooth, yellowish, longitudinal lines generally present and quite well defined. *Origin:* California; reported by L. L. Bequette, of Rivera, Cal., but practically unknown in that section, as it proved of little value; crop of 1890.

Grenoble.

A term loosely used to designate the French-grown Mayette or to include the three leading varieties in the Grenoble district of France, viz, Mayette, Franquette, Parisienne. The nut shown in Plate IV, called Grenoble by the growers, T. B. Bishop Co., is really a form of Santa Barbara and not one of the three varieties here named.

Hales.

Persian Long type, modified; above medium to large; rather narrowly oblong; base obtuse to almost truncate, some specimens will stand obliquely on end; apex obtuse, usually more or less retuse, resulting from prominent shoulders, strong mucronate tip; sutures strongly ribbed, with deep, broad, and variable pits at the equator; flange very broad, strongly sealed; shell thin, moderately yellowish, fairly smooth except along sutures, amply veined and somewhat marked by small, deep pits, longitudinal lines very much broken, though not infrequently well defined but shallow and narrow; diaphragm weak shouldered, thin, and rarely persistent; kernel of shrunken appearence though filling the shell, convolutions strongly pronounced and variable; pellicle brownish, very slightly astringent; veins ample, well defined, and darker brown; flesh firm, crisp, only moderately oily; flavor very sweet, mild, pleasant; quality very good. *Origin:* Original tree grew on the property of W. L. Hale, Fullerton, Cal; specimens grown by J. B. Neff; crop of 1911 (Pl. IX).

Though this variety has not been given general trial, a few leading growers are testing it, and the following report is by J. B. Neff: "It is showing fairly well in blight-resistant qualities—in fact, better than any other variety that I have—but while the nuts are large and fine, it does not produce as large crops as some others."

Hall.

Bijou type; very large; oblong angular, usually tapering to the base; base rounded with the sutures but obtuse at right angles; apex obtuse to slightly acute, with rather strong blunt point; sutures appressed or very slightly ribbed, deeply and broadly pitted at the equator; flange broad, very firmly sealed; shell rather thick, brown with broad patches of yellowish gray-brown, very rough with irregular convolutions, pits and depressions, longitudinal lines rarely marked; diaphragm firmly shouldered and usually persistent; kernel shrunken, convolutions very variable and broken; pellicle yellowish, astringent, veining inconspicuous; flesh firm, rather dry; flavor mild; quality fair. *Origin:* Chance seedling in Germany transplanted at the age of 1 year to a place near Avonia, Pa.; specimens supplied by L. C. Hall, crop of 1910 (Pl. III).

Hays.

Brantome type; medium; oblong, inclined to angularity; base obtuse to truncate, nearly half will stand erect; apex obtuse, occasionally retuse or acute, scarcely mucronate; sutures appressed toward the base, moderately ribbed at center and toward apex, pits at the equator variable; flange narrow to medium, fairly well sealed; shell thin, yellowish brown to brownish, roughened with irregular depressions and protuberances, longitudinal lines rarely defined; diaphragm strongly shouldered and inclined to be persistent; kernel quite full, moderately plump, convolutions moderate, variable, and broken; pellicle yellowish brown, glossy, astringent, veins few, darker brown; flesh crisp, grain fine, oily; flavor and quality not determinable, through age of specimens. *Origin:* A seedling on the property of Amos H. Hays, Parkton, Md., and named by H. E. Van Deman about 1904; specimens grown by Mr. Hays, crop of 1908 (Pl. IX).

Hightstown.[1]

Medium, long, ovate; shell fairly thin; kernel plump and good. A variety grown and propagated at Hightstown, N. J.; hardy and fruitful when planted in groups, as, like the chestnut, isolated trees rarely bear nuts.

Hindes Perfection.

Synonym of Placentia.

Hindes Perfection Placentia.

Synonym of Placentia.

Hindes Placentia.

Synonym of Placentia.

Holden.

Marbot type; above medium; oblong to narrowly oblong; base rounded, occasionally obtuse; apex rounded or obtuse, mucronate sutures moderately to strongly ribbed, scarcely pitted at the equator; flange broad, firmly sealed; shell grayish yellow to light yellow, moderately smooth, scattered shallow depressions, longitudinal lines usually inconspicuous; diaphragm strong and firmly shouldered; kernel quite full, convolutions moderate; pellicle light ground with darker tinge, semiglossy, astringent, veining indifferent but dark; flesh oily, rich; flavor sweet; quality good. *Origin:* Chance seedling on the property of E. B. Holden, Hilton, N. Y.; specimens grown by Mr. Holden, crop of 1910 (Pl. VII).

Honeydew.

Mayette type; large, oblong; loose, obliquely obtuse; apex obtuse with strong point; sutures rather strongly ribbed at the equator, but appressed toward the base, where abrupt enlargements along the sutures characterize the form of the nut; usually strongly pitted at the equator; shell rich yellow, rather rough from irregular basal protuberances and deep irregular depressions along pronounced sutures and longitudinal lines. *Origin:* Obtained by F. A. Leib from scions imported from France; a decided improvement in appearance over the usual Mayette obtained in a similar manner; specimen grown by Mr. Leib as first crop, 1910 (Pl. III).

Hubbard.

Sorrento type; above medium; oblong; base rounded; apex acute, with rather strong point; sutures slightly ribbed at the equator, appressed at both ends, especially at the base, usually pitted at the equator; flange very firmly sealed; shell grayish brown, quite smooth, though longitudinal lines are more or less well defined. *Origin:* California; specimens supplied by E. M. Price, crop of 1910 (Pl. VIII).

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[1] J. L. Budd, in the American Horticultural Manual, pt. 2, 1903.

To the planter who fancies this type of nut, by some called pecan-walnut and known in the market as the Italian walnut, the Hubbard promises to fulfill the demand for appearance. It is to be propagated by budding, and data to determine its value will soon be available.

Ignotum.

A name applied to a variety obtained from crossing *Juglans regia* with *Juglans cinerea*. Both tree and nut of botanical interest only.

Jauge.

Synonym of Mammoth.

Journeay.

Santa Barbara type; large; broadly oblong, or occasionally obovate and angular; base obtuse, or even obliquely truncate; apex obtuse, with strong point; sutures strongly ribbed, usually pitted at the equator; flange very firmly sealed; shell grayish yellow, roughened by numerous and often deep pits and irregular depressions; longitudinal lines rarely evident. *Origin:* Chance seedling from a Chilean nut planted in California; specimens supplied by E. M. Price, crop of 1910 (Pl. VIII).

Juglans monoheterophylla.

Synonym of *Juglans regia monophylla*. On the grounds of the Department of Agriculture at Washington is a tree of this very interesting variety marked under the synonym. As the specific name implies, the leaves are simple and variable. Those at the base of the shoots are usually broadly ovate with cordate bases, while those above vary from broadly oblong-lanceolate to narrowly lanceolate. The original tree, long since destroyed, was first observed as a chance seedling at St. Foy, near Dieppe, France, in 1833. In 1865 Carrière records (Revue Horticole, p. 130) that only two trees directly produced from the original were then in existence. The tree in Washington is small, with numerous slender branches, and is chiefly interesting on account of its remarkable foliage. The fruit is said to be of indifferent quality. Of botanical interest only.

Juglans racemosa.

Synonym of Cluster. Of this species the late Felix Gillet said: "It is a fact that the nuts are borne in clusters; aside from this character, the tree, foliage, and fruit resemble, or are even identical with, *Juglans regia*."

Juglans regia laciniata.

Synonym of Cutleaf.

Juglans regia pendula.

A specimen tree on the grounds of the United States Department of Agriculture is of moderate vigor, hardy, sprawling, somewhat pendulous, with leaves of medium size. The writer has had no opportunity to examine the fruit. A few nuts set in 1911 were probably taken before maturity by squirrels. If this authentic specimen of *Juglans regia pendula* is a fair sample, hundreds of the younger trees in California, notably in the Vrooman orchard, afford a far greater display of long, slender, pendulous branches. These are pruned each year, so that there are no examples of the kind of tree such growths would ultimately produce.

Kaghazi.

Persian Long type; above medium to large; oblong, occasionally roundish and angular, lower half usually narrowed; base rounded; apex acute or obtuse on the rounded specimens, usually with strong point; sutures moderately ribbed, more or less pitted at the equator; flange variable, firmly sealed; shell grayish brown to yellowish, rather rough, with irregular depressions, longitudinal lines more or less distinct as pitted furrows; dia-

phragm firmly shouldered, strong and frequently persistent; kernel full, convolutions small, irregular, and separate; pellicle light brown, glossy, astringent; veining distinct though sparse; flesh rather coarse, oily, rich; flavor sweet; quality good. *Origin:* Nuts obtained through the American consul in Persia were planted by Mr. Meak, of Haywards, Cal., and from these were produced two trees, the nuts of which were deemed especially meritorious. To these trees was given the name Kaghazi. The nuts of both trees have been used for propagation, and in consequence more or less variation exists in the type of nut, but probably no more than would be the case from any seedling trees. Specimens grown by A. L. Linquist, crop of 1910 (Pl. VI).

The trees of this variety grown near Goleta, Cal., have not been attacked by blight and are considered by Mr. Linquist and others to be blight resistant, if not altogether immune. The test will not be complete until blight has attacked in this same orchard other varieties susceptible elsewhere. Should the Kaghazi then remain free from injury, its resistance will be beyond question.

Keesling.

Persian Long type, modified; above medium to large; elliptic usually, though not infrequently oblong or occasionally almost obovate; base obtuse or rounded; apex obtuse, rounded, or even acute and usually with a strongly mucronate tip; sutures appressed to slightly ribbed, equatorial pits not pronounced and often not present; flange broad, fairly well sealed; shell rather thick, yellow, but frequently with an indifferent grayish overcast, quite regular, rather smooth, though an occasional nut is rough, with deep pits, broken lines, and furrows, longitudinal lines usually distinct; diaphragm weakly shouldered, thin, and very rarely persistent; kernel full, plump, convolutions moderate, irregular, and variable; pellicle dull to semiglossy pale brownish, quite astringent; veins few, inconspicuous; flesh crisp, oily; flavor mildly nutty; quality fair to good. *Origin:* A seedling on the property of Horace G. Keesling, San Jose, Cal., from nuts planted in 1879; specimens from grafted trees on Mr. Keesling's property, crop of 1911 (Pl. IX).

The tree is reputed to be prolific and regular. On the whole the variety appears to be worthy of trial. We are not informed as to its resistance to blight.

Klondike.

Bijou type; very large; oblong to obovate; base rounded or even long tapered; apex rounded to obtuse, mucronate; sutures appressed, usually pitted at the equator; flange narrow, many nuts imperfectly sealed; shell thick, grayish brown to yellowish brown, rough, with numerous irregular depressions and broken furrows, or quite smooth; longitudinal lines more or less distinct; diaphragm weak shouldered, though strong and frequently persistent; kernel not full, convolutions irregular, uneven, and moderate; pellicle brown tinged, mildly astringent, dull; veining generally distinct and dark; flesh coarse, rather dry; flavor sweet; quality fair. *Origin:* During the decade 1880–1890 Mr. T. L. Gooch, of Rivera, Cal., obtained specimens of nuts imported by a San Francisco firm, and from these planted by Mr. Gooch and a neighbor, Jacob Ott, to whom he had given a few, were produced two trees yielding nuts of large size and unusual shape, named Klondike by the attendants at the local packing house; specimens grown by A. L. Linquist, crop of 1910 (Pl. III).

Laciniated.

Synonym of Cutleaf.

Lane.

Santa Barbara type; above medium to large; roundish to broadly oblong; base obtuse to almost acute; apex usually acute with strong point, though sometimes rounded; sutures moderately ribbed nearly the whole length on one side while appressed near the base on the other, equatorial pits variable, sometimes wholly absent; flange usually narrow, scarcely medium, rather weakly sealed; shell thin, occasionally very thin, yellowish, smooth; well-defined longitudinal lines infrequent; diaphragm weakly shouldered, scarcely persistent; kernel full, plump, convolutions moderate, fairly regular; pellicle yellowish tinged with brown, dull, mildly astringent; veins inconspicuous; flesh crisp, medium grain, oily; flavor mild, sweet, pleasant; quality good. *Origin:* Seedling originating in Santa Barbara County, Cal., on the ranch of W. H. Johnson; specimens from grafted trees on the property of Miles P. Lane, crop of 1911 (Pl. IX).

C. W. Beers, horticultural commissioner for Santa Barbara County, Cal., says "the Lane tree produces a large, smooth nut of good quality. The tree is vigorous, assumes a desirable form, and bears an abundance of fruit spurs, even to the main body. The nuts mature so nearly at the same time that the whole crop can be successfully harvested at one picking. In 1910 and 1911 the pickings were made before the last gathering of the regular Santa Barbara in the same orchard. Growing amidst trees that lost 80 per cent of their crop by blight in 1910, this tree has shown no effects of the disease, though other trees in the same orchard have been affected. The parent tree also thus far has been exempt from this trouble."

Lanfray.

Type; large-fruited variety catalogued by Felix Gillet, but not yet reported as fruiting in the United States. H. M. Williamson, Report of Oregon Board of Horticulture, 1906, says, "It is a nut of most attractive appearance and is very heavy in proportion to size, as it is so well filled with meat."

Large Fruited.

Synonym of Bijou.

Large-Pointed Præparturiens.

Ascribed to Felix Gillet in Bulletin 92, Oregon Agricultural Experiment Station.

Late.

Synonym of Serotina.

Late Fertile.

Fertile type, small; broadly oblong to obovate; base rounded, obtuse, or occasionally truncate; apex obtuse, mucronate; sutures, strongly ribbed; broad pits at the equator usually present; flange narrow, very firmly sealed; shell yellowish, somewhat roughened, rather thick, longitudinal lines not conspicuous though generally present. *Origin:* Chance seedling at Barren Hill Nurseries; specimen grown by Felix Gillet; second generation, crop of 1891 (Pl. VIII).

Mr. Gillet said of this variety: "It is late in vegetating and hence hardy; kernel is full fleshed and very sweet."

Late Præparturiens.

Synonym of Late Fertile.

Lea.

Montignac type; medium to small; roundish, angular, occasionally tapered toward apex; base obtuse truncate, many specimens will stand erect; apex obtusely rounded, scarcely any tip; sutures slightly to broadly ribbed over upper half, appressed below; variously pitted at the equator, pits usually indifferent; flange very narrow, firmly sealed; shell very thin, grayish brown to yellowish, moderately smooth, longitudinal lines rarely well defined; diaphragm strongly shouldered, strong, and persistent; kernel full, plump, convolutions moderate, broken, variable; pellicle brownish, dull to semiglossy, very mildly astringent; veins inconspicuous; flesh crisp, starchy, moderately oily; flavor mild, sweet; quality fair. *Origin:* Wilmington, Del., about 20 years ago. It is a seedling from another tree, also a seedling, planted in the locality about 40 years ago. It began bearing at 8 or 9 years of age and has borne yearly since. Owing to the thin shell of the nut, blackbirds do considerable damage to the crop. It is in excellent repute for pickling, being superior in flavor to other varieties used for this purpose. Specimens grown by Miss Lea, Wilmington, Del., crop of 1911 (Pl. IX).

Longbeaked.

A variety catalogued by the Georgia Horticultural Society in its report for 1900. Probably a synonym for Serotina.

Los Angeles.

Synonym of Mission.

Mammoth.

Bijou type; an immense nut, the largest yet originated. So large are the shells of some that "ladies' companions," wherein to stow away gloves and handkerchiefs, are made from such shells by fancy-goods manufacturers. The nut though of such large dimensions has a thin shell and the kernel is of first quality.[1]

Mammoth Fertile.

A large-fruited variety of the Fertile that originated in France. The nut is extraordinarily large; soft shell; full-fleshed kernel.[1]

Mayette.

Type, Kerr form; large; ovate, rarely oblong; base obtuse; apex obtuse to slightly acute with mucronate tip; sutures appressed to slightly ribbed, pitted at the equator; flange narrow, very firmly sealed; shell thin, grayish yellow, quite smooth except along the sutures, longitudinal lines quite distinct; diaphragm usually weakly shouldered, thin, and rarely persistent; kernel full, only moderately plump, convolutions pronounced, somewhat irregular, pellicle grayish yellow, glossy, very slightly astringent; veins sparse, but usually well defined by their darker color; flesh oily, rich; flavor sweet; quality very good. *Origin:* France; specimens grown by Tribble Bros., crop of 1910 (Pl. V).

Mayette Blanche.

A Mayette having a light-colored or whitish flesh.

Mayette Longue, Mayette Ronde, and Mayette Rouge.

A Mayette having reddish-colored flesh.

Type forms recognized as authentic in France, but not yet distinguished by American growers or in the American market.

[1] Lelong, B. M. California Walnut Industry. 1895–96.

Mayette Seedling.

A "second-generation" Mayette, grown by George C. Payne, Campbell, Cal., differs from the Kerr type in that the nut is more ovate, the upper half more tapering, and apex more acute; the shell is a rich yellow, the sutures not quite so firmly sealed, and the flavor better.

A type of Mayette grown by Thomas Prince, Dundee, Oreg., conforms very closely to the Payne "second generation" type in both color and form, though there is a larger percentage of oblong specimens; they have a reddish tone added to the rich yellow of the Payne Mayette; they are perceptibly smaller, though very uniform, with a kernel that is sweeter and less oily.

A seedling Mayette grown by Ely I. Hutchinson, Concord, Cal., conforms in color and form very closely to the Kerr type, though somewhat smaller, with a rather sweeter and more oily kernel.

A seedling Mayette grown by E. Terpenning, Eugene, Oreg., is medium in size, very sweet, and firmly sealed. The tree is reputed to be a regular and heavy bearer.

Mayquette.

Franquette type; above medium to large; oblong, with upper half tapered and somewhat angular; base obtuse to slightly rounded; apex acute or occasionally obtuse, with rather strong point; sutures strongly ribbed, pitted at the equator; flange broad, very firmly sealed; shell rather thick, roughened with irregular protuberances and irregular variable depressions and pits and a few deep-seated veins, longitudinal lines usually well defined; diaphragm strongly shouldered, thin but usually persistent; kernel full, plump, convolutions pronounced and broken; pellicle brownish tinged, glossy, slightly astringent; veins inconspicuous; flesh crisp, oily, starchy; flavor moderately sweet, pleasant, mild; quality fair to good. *Origin:* A seedling from artificial pollination of Franquette × Mayette by Tribble Bros., Elk Grove, Cal.; specimens from the above firm, crop of 1910 (Pls. VI and X).

Mesange.

Modified Franquette type; small, oblong to oblong ovate; base obtuse, rarely truncate; apex acute with strong point; sutures somewhat appressed toward the base, moderately to strongly ribbed above, slight pits usually present at the equator; flange narrow, very firmly sealed; shell yellowish or grayish yellow, thin, more or less roughened by slight irregular depressions; variable furrows and small protuberances; longitudinal lines commonly present and well defined. *Origin:* Europe; specimens grown by Felix Gillet; second generation, crop of 1891. Introduced by Mr. Gillet. Elicited from the importer the following comment after its first fruiting in this country: "It is so named from the fact that the shell is so thin that the titlark, though a little bird, can pierce it and thus feed upon the kernel. The tree is very productive, while the nut is excellent for dessert and pickling, and is quite rich in oil."

Meylan.

Type; above medium; ovate or broadly oblong; base truncate; apex obtuse or acute, mucronate; sutures appressed to slightly ribbed, slight depressions, rarely a small pit at the equator; flange narrow to moderate, very firmly sealed; shell thin, rich yellow, smooth and regular, longitudinal lines frequently well defined; diaphragm firmly shouldered, thin and yielding; kernel full, moderately plump, convolutions moderate, irregular; pellicle

light yellowish, glossy or dull, very slightly astringent, veins sometimes abundant, giving the kernel a brownish cast; flesh very oily, rich; flavor sweet, pleasant; quality best. *Origin:* Europe; specimens grown by Ely I. Hutchinson, crop of 1910 (Pl. III).

A type of Meylan grown by Mr. Prince is somewhat smaller and darker with veins of the shell more conspicuous, kernel somewhat darker and not so plump though sweeter and less oily.

Milbank.

Parisienne type; above medium; oblong; base obliquely obtuse to obliquely truncate, about half will stand nearly erect upon base; apex obtuse, often more or less oblique, and apparently depressed as result of prominent shoulders, tip varies from practically none to an occasional rounded one of some strength; sutures with basal half appressed, apical half more or less ribbed, equatorial pits less pronounced than in the type but usually present at least on one side, occasionally quite deep depressions near the base; flange broad, usually firmly sealed though not difficult of separation; shell moderately thin, of pleasing yellowish color, moderately smooth, though well marked with shallow veining, longitudinal lines distinct though often irregular and broken; diaphragm strongly shouldered at basal end in particular and usually persistent; kernel full, convolutions rather strong and variable though moderately smooth, veins indistinct; pellicle light glossy to semi-glossy, mildly astringent; flesh tender, crisp, moderately rich; flavor mild, rather sweet and pleasant; quality good. *Origin:* A seedling planted on the property of the late Mrs. Jeriamah Milbank, in Connecticut, about 1876; specimens from the original tree, crop of 1911 (Pl. IX).

While the tree is not a heavy bearer, it produces a good average annual crop and is said to be a robust, vigorous grower.

Mission.

Type; medium; oblong or obovate and somewhat angular; base obtuse to rounded; apex obtuse with mucronate tip or strong point; sutures from slightly to strongly ribbed, indifferently pitted at the equator; flange usually broad, firmly sealed; shell grayish brown, thickened by numerous irregular protuberances and roughened by pits and depressions, longitudinal lines occasionally well defined. *Origin:* California; specimens grown by Charles S. Wilcoxon, crop of 1891.

This variety was planted by the Spanish padres about the early missions in California. It is not now of commercial importance nor of varietal consequence. It is also known as Santa Barbara Hardshell.

Mobart.

Merely listed and illustrated by Lelong in his treatise entitled "California Walnut Industry."

Mount.

Marbot type; medium; oblong, somewhat angular and occasionally tapering to the base; base rounded to acute; apex obtuse, infrequently truncate, mucronate; sutures quite strongly ribbed, sometimes pitted at the equator, but usually merely slight depressions; flange moderate, very firmly sealed; shell rather thick, bright yellow, moderately smooth, longitudinal lines usually present and well defined though sometimes variously broken; diaphragm rather thick, firmly shouldered, frequently persistent; kernel quite full, fairly plump, convolutions moderate, irregular and broken; pellicle reddish, dull, astringent; veins inconspicuous; flesh somewhat coarse, oily; flavor indifferent; quality fair. *Origin:* Original tree is growing upon the property of Joseph S. Mount, Hamilton Square, N. J.; was planted as a

small tree in 1884 and has borne more or less of a crop since 1890, when it produced its first fruit; specimens grown by Mr. Mount, crop of 1909 (Pl. VIII).

Nebo.

Parisienne type; large; broadly oblong to oblong ovate; base obtusely rounded; apex retuse with very slight mucronate point; sutures strongly ribbed above but depressed below and distinctly pitted at the equator. *Origin:* Chance seedling in Lancaster County, Pa.; specimens supplied by J. G. Rush, crop of 1910 (Pl. V).

Neff.

Santa Barbara type; large; roundish oblong, occasionally tapering toward the base, quite angular and irregular; base rounded and usually with one lobe projecting; apex obtuse with strong point; sutures quite strongly ribbed, occasionally pitted at the equator; flange broad, only moderately sealed; shell rather thick, grayish yellow, roughened with numerous depressions, largely due to strong veining and slight rounded protuberances, longitudinal lines quite well defined though usually broken; diaphragm strongly shouldered but thin and yielding, scarcely persistent; kernel moderately full and plump, convolutions usually slight though variable and broken; pellicle with a decided brownish tinge, glossy, mildly astringent; veins dark and well defined; flesh rather crisp, oily; flavor sweet, mild, pleasant; quality good. *Origin:* A tree obtained from a local nursery dealing in seedling stock planted among other trees from the same nursery at the same time—1892—by J. B. Neff, Anaheim, Cal.; Mr. Neff reports it to be the most prolific and regular bearer that he has. He also says: "It is not the smooth nut that I would like." Specimens grown by Mr. Neff, crop of 1910 (Pl. V).

Neff Prolific.

Synonym of Neff.

Norman.

Synonym of Pomeroy.

Papershell.

Synonym of Mesange. The term "Papershell" is also used for a variety with a very thin shell, formerly planted in California, but discarded as wholly unfit for the commercial orchard because the tree is a shy bearer, though the nut is of high quality.

Paradox.

A name first used by Luther Burbank in 1897–98 to designate a tree from a nut produced by a cross-fertilization of *Juglans regia* and *J. californica*. The term is now used to distinguish any tree arising from the cross-fertilization of these two species (Pl. II).

Parisienne.

Type; above medium to large; oblong, upper half often tapers to such extent that it has the appearance of being ovate; base obliquely obtuse; apex usually obtuse, though occasionally rounded with mucronate tip; sutures appressed to slightly ribbed, usually deep pitted at the equator, which is often below a median line; flange narrow to moderately broad, firmly sealed; shell thin, brownish, roughened with numerous irregular and shallow pits, longitudinal lines variable, usually indistinct; diaphragm weakly shouldered, thin but strong; kernel full, convolutions moderate, regular, and rather smooth; pellicle light, glossy, mildly astringent; flesh tender, oily, rich; flavor sweet; quality very good. *Origin:* Southeastern France nearly 200 years ago. Now rated by the French as one of the three highest quality dessert nuts. Specimens grown by George C. Payne; crop of 1911 (Pl. V).

Parry.

Illustrated in American Fruit and Nut Journal, June, 1908; also in Bulletin 92, Oregon Agricultural Experiment Station, in which publication it is said to be of medium size and rather flat at the base.

Payne.

Franquette type; above medium; oblong with upper half narrowed, or even almost tapering to the apex; base obtuse to rounded; apex sometimes rounded, usually acute with a strong point; sutures strongly ribbed, only moderately or not at all pitted at the equator; flange moderate and variable, firmly sealed; shell moderately thin, yellowish, rather smooth, though usually more or less furrowed and pitted with shallow depressions; diaphragm firmly shouldered but thin and weak; kernel full, convolutions even and moderate; pellicle light to slightly tinged with brown, very slightly astringent, veining slightly dark, though not pronounced; flesh rather dry; flavor mild, hardly sweet; quality fair. *Origin:* Accidental seedling discovered at Campbell, Cal., by George C. Payne, about 1898; parentage unknown, but of Franquette type. Specimens grown by Mr. Payne; crop of 1910 (Pl. VII).

Of this nut an Oregon grower, Mr. Ferd Groner, says: "It is a fine nut, but the blight affects it seriously. It is not adapted to Oregon conditions because it blossoms too early."

Payou.

Bijou type; very large; oblong, usually somewhat angular and narrowed at the base; base rounded; apex obtuse, mucronate; sutures appressed or slightly ribbed, narrowly and deeply pitted at the equator, which usually lies above a median line; flange narrow, imperfectly sealed; shell moderately thin, yellowish brown to darker, very rough with irregular convolutions and numerous depressions, longitudinal lines frequently evidenced by a series of narrow, deep pits; diaphragm firmly shouldered but thin and weak; kernel quite full, convolutions regular and large; pellicle rather dark, glossy, slightly astringent, veining quite pronounced and dark; flesh oily, rich; flavor sweet; quality very good. *Origin:* Offspring of a cross between Bijou and Payne made by George C. Payne in 1903 or 1904; specimens grown by G. C. Payne, the originator; crop of 1910 (Pl. III).

Pear Shape.

Synonym of Vilmorin.

Peerless (Papershell).

Bijou type. Originated with Mrs. Rebecca E. Semple, Burlington, N. J., from a nut planted by her in 1893. Reported as promising for Maryland in Bulletin 125, Maryland Agricultural Experiment Station. Considering the type to which the name "Papershell" has been applied in the past, the term is a positive misnomer.

Persian.

Type; medium; roundish oblong; base obliquely obtuse to rounded; apex obtuse to acute with mucronate tip; sutures moderately to quite strongly ribbed, irregularly pitted at the equator; flange moderate, very firmly sealed; shell thin, grayish yellow, rather thick, strong, moderately rough with numerous depressions and a few protuberances, longitudinal lines indistinct; diaphragm weakly shouldered, thin, scarcely persistent; kernel full, plump, convolutions large and variable; pellicle light yellowish brown, glossy, scarcely astringent, veins not conspicuous; flesh crisp, slightly oily; flavor very sweet, mild; quality good. *Origin:* Imported from France; specimens grown by Ely I. Hutchinson; crop of 1910 (Pl. IV).

Though Persian is a generic commercial term in general use, it is used in this case by Mr. Hutchinson and some others to designate a particular type of nut of medium size that has made a record for productiveness, while at the same time possessing considerable merit as a nut of high quality. It can hardly be classed as a "soft-shell" in the strict meaning of the term.

Persian Dwarf Prolific.

Synonym of Fertile.

Persian (round).

Nuts of the crop of 1911 were imported by the Office of Foreign Seed and Plant Introduction, Bureau of Plant Industry.

Placentia.

Santa Barbara type; large, decidedly angular; obovate to oblong; base rounded; apex obtuse to rounded, mucronate; sutures decidedly appressed, small, deep pits, few to none at the equator; flange narrow, firmly sealed, though a considerable number of specimens are imperfectly closed at apex; shell thin, dark brown, mottled with gray, rough with numerous pits of various sizes and broken ribs, longitudinal lines negligible; diaphragm variable, though usually more or less persistent; kernel full size though not plump, convolutions variable and irregular; pellicle light yellowish brown, more or less glossy, slightly astringent, veins few but sometimes quite pronounced by their dark color; flesh moderately oily; flavor sweet; quality good. *Origin:* Chance seedling about 1890 in Orange County, Cal.; specimens grown by J. B. Neff; crop of 1910 (Pls. VI and XI).

Placentia Perfection.

Synonym of Placentia.

Pomeroy.

Small; oblong; base rounded; apex rounded, occasionally slightly pointed, usually mucronate; sutures appressed or occasionally very slightly ribbed, scarcely pitted at the equator; flange broad, firmly sealed; shell smooth, thick, grayish brown to light yellowish, longitudinal lines inconspicuous; diaphragm strong, firmly shouldered, persistent; kernel full, convolutions moderate; pellicle light yellowish, astringent, veining generally inconspicuous; flesh moderately oily; flavor very sweet; quality good. *Origin:* With the late Norman Pomeroy, Lockport, N. Y., from nuts obtained by him from a tree in Philadelphia, and planted in 1876; specimens grown by Mr. Pomeroy, crop of 1910 (Pl. X).

Poorman.

Listed by Lelong, in "California Walnut Industry," as a variety of recent introduction.

Precocious.

Synonym of Fertile.

Prince.

Persian Long type; large; oblong to narrowly oblong, tapering to apex; base rounded; apex acute, occasionally obtuse, mucronate pointed; sutures appressed, moderately or not at all pitted at the equator; flange variable, usually narrow, not quite firmly sealed; shell dark brown, very conspicuously marked with narrow and slightly depressed veins producing the appearance of roughness while in truth it is quite smooth and even, longitudinal lines variable; diaphragm usually firmly shouldered, thin but strong and at times persistent; kernel not quite full, rather irregular, convolutions variable, generally only moderate; pellicle light yellow to brownish, glossy, mildly astringent; flesh moderately oily; flavor sweet, rich;

quality good. *Origin:* Chance seedling with the late Felix Gillet, California, about 1895; specimens grown by Mr. Prince, crop of 1910 (Pls. VII and XI).

Sold with others to fill an order for trees supplied to Thomas Prince, Dundee, Oreg. Its distinct form, size, and color so easily distinguished it from the other nuts in the orchard that it was given the above name after fruiting a few times. Unfortunately, it is not blight resistant at its home.

Prince of Yamhill.

Synonym of Prince.

Prolific.

Persian Long type; large; oblong to obovate; base rounded; apex usually acute with point obtuse or mucronate; sutures moderately or even strongly ribbed, rarely pitted at the equator; flange usually broad, firmly sealed; shell thin, grayish brown, roughened with numerous irregular and frequently rather deep pits and depressions, longitudinal lines usually present and well defined; diaphragm almost weakly shouldered, thin and yielding, rarely persistent; kernel full, plump, convolutions moderate and quite regular; pellicle rather dark (probably due to climate), glossy, astringent; flesh rather rich, very oily; flavor sweet; quality good. *Origin:* Chance seedling with E. G. Ware, Garden Grove, Cal., from a Santa Barbara nut obtained from the Sexton place; first propagated by grafting in 1899; well worth extended trial; specimens grown by Mr. Ware, crop of 1910 (Pl. VII).

Præparturiens or Præparturiens.

Synonym of Fertile.

Rivera Hardshell and Rivera Softshell.

Listed and illustrated by Lelong in his treatise entitled "California Walnut Industry."

Royal.

A name first used by Luther Burbank in 1897–98 for a tree from a nut produced by a cross-fertilization of *Juglans californica* and *J. nigra*. The name is applied to any tree that is the offspring of cross-fertilization between these two species (Pl. II).

Rush.

Parisienne type; medium; roundish oblong to oblong, occasionally somewhat oblique; base obtuse truncate; apex very slightly rounded or even depressed; scarcely mucronate; sutures appressed or slightly ribbed, usually slightly pitted at the equator; flange broad, very firmly sealed; shell grayish brown, roughened by numerous small, shallow depressions, longitudinal lines inconspicuous; diaphragm firmly shouldered, strong and persistent; kernel full, convolutions moderate; pellicle light golden tinge, slightly astringent, glossy; veining moderate and dark; flesh medium texture, moderately oily; flavor sweet, rich; quality good. *Origin:* Chance seedling in 1886, with J. G. Rush, West Willow, Pa.; specimens grown by Mr. Rush, crop of 1910 (Pl. VII).

Santa Barbara.

Type; above medium to large; form variable, oblong or broadly oblong, the lower half frequently tapering and occasionally oblique; base rounded; apex obtuse to acute with mucronate tip or firm point; sutures medium to strongly ribbed or sometimes appressed, not infrequently pitted at the equator; flange variable, firmly sealed; shell moderately thin, grayish, or yellowish; from quite rough to moderately smooth, longitudinal lines negligible; diaphragm rather weakly shouldered, thin and scarcely persistent; kernel full, rather plump, convolutions moderate, irregular, and broken;

pellicle yellowish brown, slightly astringent, glossy, veins rather numerous, especially the smaller ones noticeable; flesh rather dry; flavor moderately sweet; quality good to very good. *Origin:* Chance seedling from nuts thought to have been imported from Chile planted in Santa Barbara County, Cal., by Joseph Sexton in 1886; specimens grown on La Patera Ranch, crop of 1910 (Pl. IV).

The type of this variety is extremely variable in minor details, a result of the practice of propagating from nuts selected to meet the ideas of the respective growers. While these ideas coincide in a general way, there are marked differences as to form, and at best growers do not confine themselves closely to definite ideals. It is easily understood that the production of uniform nuts is difficult to attain from seedlings, and so long as this method is pursued we can hardly expect to have other than a very variable type.

Santa Barbara (More form).

The favorite form of the Santa Barbara as selected by John F. More; somewhat more angular than the nut described; a more pronounced apical point; rougher; sutures more strongly ribbed. Specimens grown by Mr. More, crop of 1910 (Pl. IV).

Santa Barbara (Williams form).

An improved form of Santa Barbara selected by George M. Williams. The sutures are more appressed and the nut smoother, though in other respects conforming closely to the general type of this variety as now propagated in southern California. Specimens grown by Mr. Williams, crop of 1910 (Pl. IV).

Santa Barbara Softshell.

Synonym of Santa Barbara.

San Jose Mayette.

Synonym of Wiltz.

Santa Rosa.

Santa Barbara type; above medium to large; oblong with broadly oblong or tapering lower half; base rounded and commonly oblique; apex acute or obtuse with strong point; sutures strongly ribbed, rarely pitted at the equator; flange variable, only moderately sealed; shell thin, grayish to yellowish, roughened particularly along the sutures by irregular depressions, pits, and protuberances, longitudinal lines infrequent, occasionally well defined; diaphragm firmly shouldered, generally thin and weak, rarely persistent; kernel full, moderately plump, convolutions pronounced and variable; pellicle rich yellowish brown, glossy, astringent, veins rather sparse, but generally well defined; flesh oily, rich; flavor sweet; quality good. *Origin:* Chance seedling at San Francisco years ago, but later moved to Santa Rosa, where it now stands; first introduced by Luther Burbank in 1882–83; specimens grown by George C. Payne, crop of 1910 (Pl. IV).

Serotina.

Franquette type, modified; small; ovate, occasionally somewhat oblong; base obtuse to truncate; apex acute to acuminate, with strong point; sutures appressed at the base, moderately to strongly ribbed above, pits at the equator, narrow and deep; flange moderate, very firmly sealed; shell yellowish, smooth, rather thin, longitudinal lines usually well defined; diaphragm thick, strongly shouldered, and often more or less persistent. *Origin:* Europe; specimens grown by Felix Gillet; second generation, crop of 1891 (Pl. VIII).

In a brief description of this variety in 1887–88, Mr. Gillet said: "This variety is of especial value for planting in those districts where late spring frosts prevail, as it is very late in vegetating. The tree is very prolific and the nut is of medium size, well shaped, with a very sweet and highly flavored kernel."

Sexton.

Originated with Joseph Sexton, in California, but not a well-defined variety with individual merit, and not propagated.

Sexton's Papershell and Sexton's Softshell.

Synonyms of Santa Barbara.

Sinclair.

Parisienne type; above medium to large; broadly oblong; base obtuse truncate; apex obtuse to slightly retuse, with mucronate tip; sutures appressed at base, slightly ribbed; irregularly if at all pitted at the equator, which is above a median line; flange narrow, firmly sealed; shell medium thick, pleasing yellow, moderately smooth, though the abundant veining gives it the appearance of roughness, longitudinal lines usually present and well defined; diaphragm strongly shouldered, rather thick, and somewhat persistent; kernel full, plump, convolutions moderate and variable; pellicle dark, semiglossy, very astringent; veins ample and dark; flesh crisp, rather oily, and starchy; flavor insipid; quality fair. *Origin:* A seedling on the property of L. J. Onion, Harford County, Md.; specimens from Mr. Onion, crop of 1911 (Pl. IX).

Smith's Favorite.

Synonym of Favorite.

Stocktonian.

Franquette type, slightly modified; large; oblong to oblong ovate, or even occasionally elliptic; base obtuse or irregularly rounded; apex obtuse to acute with short, strong point; sutures rather strongly ribbed, indifferently pitted toward the base; flange broad and quite firmly sealed; shell moderately thin, bright yellow, somewhat roughened by various irregular depressions, longitudinal lines almost absent; diaphragm strongly shouldered, rather heavy and persistent; kernel only moderately full, not plump, convolutions variable, but usually pronounced; pellicle dull, light brown, astringent; veins inconspicuous; flesh starchy, oily; flavor indifferent; quality fair. *Origin:* E. M. Price says: "It is a seedling of Serotina; bears every year, and is prolific; blossoms early and has not yet been affected by blight." Specimens supplied by E. M. Price, crop of 1910.

Teague.

Santa Barbara type; medium, though rather variable in size and also form; roundish oblong to broadly oblong with decidedly tapering base in many specimens; base obliquely obtuse to rounded or even acute; apex obtuse or acute, mucronate tip to firm point; sutures moderate to strongly ribbed, rarely pitted at the equator; flange usually broad, firmly sealed, though frequent specimens are imperfectly closed; shell thin, yellowish, varying from quite smooth to roughened by numerous irregular shallow depressions and protuberances, longitudinal lines rarely noticeable; diaphragm weakly shouldered, thin, and scarcely persistent; kernel very full and plump, convolutions variable, moderate; pellicle light yellow tinged with brown, dull, semiglossy, slightly astringent, veins numerous and brown to dark brown; flesh oily; flavor moderately sweet; quality fair. *Origin:* Chance seedling of the Santa Barbara; planted in Ventura, Cal., in 1886, and reputed to be blight immune; specimens grown by Dana L. Teague, crop of 1910.

Thinshelled.

A variety catalogued by the Georgia Horticultural Society, report for 1900; possibly Hightstown, which has sometimes passed under the name of Thinshelled.

Titlark.

Synonym of Mesange.

Treyve.

Parisienne type; above medium; oblong, with an appearance of angularity; base obtuse; apex obtuse, mucronate; sutures slightly ribbed to appressed, usually strongly pitted at the equator; flange moderately broad, firmly sealed; shell brownish, mottled with gray, slightly roughened, with scattered shallow depressions and pits along the sutures, longitudinal lines depressed, generally indistinct or broken, though occasionally well defined; diaphragm strong and firmly shouldered; kernel moderately full, convolutions medium to large; pellicle very light, semiglossy, astringent, veining indistinct; flesh moderately oily; flavor moderately sweet, mild; quality good. *Origin:* France; specimens grown by Ely I. Hutchinson, crop of 1910 (Pl. VII).

Vilmorin.

A hybrid between *Juglans regia* and *J. nigra*, originating in France and introduced into the United States by Felix Gillet. "The nut has the shape of the Persian walnut, or rather that of Serotina, and the shell the appearance and hardiness of the black walnut. A very curious nut, but not desirable for market."[1]

Volga.[2]

Medium; long, ovate; shell quite thin; quality good; grown by the writer from nuts picked up at Saratov, on the Volga, in Russia. It proved hardy enough to endure winters in central Iowa, and is now propagated in Missouri.

Vourey.

Franquette type, modified; small to medium, broadly oblong ovate; base obliquely truncate; apex obtuse to acute, with firm point; sutures strongly ribbed, broadly pitted at the equator; flange narrow, firmly sealed; shell yellowish, thin, roughened by numerous irregular depressions and protuberances; diaphragm firmly shouldered, thin, though frequently persistent. *Origin:* Near Vourey, in southeastern France; specimens grown by John Rock, California Nursery Co., crop of 1891 (Pl. VIII).

Of this variety the late Felix Gillet said, "It is much the same form as Parisienne and possesses its superior quality." Of its quality the writer can not speak, since the material from which the above description was made was 9 years old, rancid, and worm-eaten; but the form, while very unlike a Parisienne, much resembles Franquette, more particularly its upper two-thirds, with a decidedly truncate base (a Mayette character), and the same strongly ribbed sutures, with an extended, firmly pointed apex. It is evident that the Rock and Gillet types of Vourey are not the same, but quite different nuts. Upon the general character of the Vourey, Berthet remarks, "This variety holds a middle place between Mayette and Franquette; it is smaller than the first and as rustic as the second." He adds that it is a dessert nut and is later than Mayette by 15 days.

[1] Catalogue, Barren Hill Nurseries, 1887–88.

[2] J. L. Budd, American Horticultural Manual, pt. 2, 1903.

From the above statements it appears that the Rock type is approximately true to the French standard and quite possibly would serve as a parent for American stock.

Ward.

Cahor type; medium to slightly above; oblong; base rounded; apex obtuse to acute, mucronate tip; sutures appressed or very slightly ribbed, rarely pitted at the equator; flange narrow to variable, firmly sealed; shell rather thin though strong, grayish brown, moderately smooth to roughened by wavy and slightly raised convolutions and narrow depressed veins, longitudinal lines rarely present; diaphragm weakly shouldered, thin, though somewhat persistent; kernel full, plump, convolutions regular, even, and pronounced; pellicle light yellow to brownish, dull, very slightly astringent; flesh crisp, slightly oily, rich; flavor sweet; quality fair to good. *Origin:* Accidental seedling with W. H. Ward, Morgan Hill, Cal., about 1897; tree hardy, prolific, thus far free from blight; specimens grown by Mr. Ward, crop of 1910 (Pl. V).

Weaver.

Fertile type, modified; small; oblong; base rounded to obliquely obtuse; apex obtuse to slightly acute, mucronate tipped; sutures slightly ribbed to somewhat appressed, more or less pitted at the equator; flange rather broad, very firmly sealed; shell brownish gray, thick, slightly roughened by numerous small, irregular depressions and an occasional pit, longitudinal lines usually present though more or less irregularly broken; diaphragm firmly shouldered, thick and persistent; kernel full, plump, convolutions very moderate, broken, and variable; pellicle brownish yellow, dull, slightly astringent; veins inconspicuous or rarely well defined; flesh oily, starchy, rather coarse; flavor insipid, scarcely sweet; quality poor to fair. *Origin:* Chance seedling on the Weaver estate near Martinsburg, W. Va.; reputed to be approximately 75 years of age and a regular and heavy bearer: specimens from the original tree, crop of 1910.

Weeping.[1]

Probably a synonym of *Juglans regia pendula.* Felix Gillet says: "Still another new and valuable variety; it derives its name from its branches drooping under the weight of nuts, we presume, like a weeping willow." Further than this we have found no record of the variety in the United States.

Willson.

A large nut of the Bijou type originating in Santa Clara County, Cal., about 1910; said by the introducer to be very precocious, productive, and blight proof.

Willson's Acme.

Synonym of Acme.

Willson's Wonder.

Synonym of Willson.

Wiltz.

Mayette type; large, broadly oblong, sometimes narrowed at base; base slightly rounded to obtuse; apex obtuse, acute pointed; sutures slightly ribbed to appressed, usually pitted at the equator; flange narrow, occasionally imperfectly sealed; shell very thin, light yellowish, moderately smooth with depressions about the sutures, longitudinal lines depressed and well defined; diaphragm weak shouldered and thin; kernel full, con-

[1] Catalogue, Barren Hill Nurseries, 1887–88.

volutions pronounced; pellicle light, semiglossy, very slightly astringent; veining inconspicuous; flesh moderately oily; flavor sweet; quality very good. *Origin:* Chance seedling discovered on the Stevens Road near San Jose, Cal., about 1892; specimens grown by R. Wiltz, crop of 1910 (Pl. XI).

This is another of the varieties recommended for trial by the University of California as promising in the work against blight.[1] The fact that one tree in the home orchard of Mr. Wiltz has grown for nine years between two trees of other varieties and while they are more or less affected with blight each year it remains free is excellent evidence that this variety promises to be blight resistant. Before positive statement can be made there must be extended trial over a wide area under variable conditions. Should it stand the test it will be widely planted, for it possesses several qualities esteemed by the dealer and consumer, being of excellent size, form, and color and of good quality and flavor. The nuts are quite uniform, with a small percentage of culls, and the tree is fairly productive, though not a robust grower. Mr. Wiltz states that the trees may be set in permanent orchard at 30 feet apart and have ample room. This is based on the growth of the tree upon its own roots. It is quite probable that the variety would make a larger growth upon the native black or hybrid stocks.

Wiltz Mayette.

Synonym of Wiltz.

WEIGHT AND MEASUREMENT.

Table II gives the weight and measurement of several hundred average specimens of Persian walnuts from the crop of 1910. The weights were made in February, 1911. The nuts had been stored so as to insure dry specimens under uniform treatment. The figures are merely approximate, as the weight of nuts varies from year to year. The variation in both the development of the kernel and in the thickness and weight of the shell depends upon climate, soil, food, and water. These figures may serve as a basis for more comprehensive work in future investigations. Allowance must be made for the personal equation in the fact that different people selected the average specimens of several varieties.

The weight gives the number of nuts to the pound; the measurements are of diameters in inches (1) at right angles to the sutures, (2) in the plane of the sutures, (3) from base to apex. The French Mayette, as sold on the New York market for 1910, is used as a leader, merely for comparative purposes.

[1] Bulletin 203, California Agricultural Experiment Station.

TABLE II.—*Average weight and size of typical specimens of Persian walnuts, by varieties.*

[Varieties illustrated in the plates are indicated by an asterisk (*).]

Variety.	Nuts to the pound.	Diameter (in inches). (1) Across sutures.	(2) Plane of sutures.	(3) Longitudinal.
Alpine*	.....	1.47	1.48	1.81
Barnes	45	1.26	1.25	1.43
Bijou*	24	1.58	1.58	1.80
Chaffee*	53	1.17	1.05	1.30
Chase*	30	1.47	1.44	1.80
Cisian*	50	1.18	1.17	1.53
Concord*	40	1.31	1.22	1.53
Constantinople*	41	1.25	1.22	1.33
Eureka*	33	1.20	1.18	1.80
Franquette* (Hutchinson)	48	1.15	1.13	1.47
Franquette (Prime)	54	1.13	1.08	1.49
Field*	30	1.47	1.37	1.72
Franquette (Hutchinson)	39	1.27	1.25	1.69
Franquette* (Vrooman)	36	1.31	1.34	1.87
Glady*	30	1.63	1.45	1.87
Hales*	41	1.22	1.30	1.62
Honeydew*	34	1.44	1.30	1.75
Hubbard*	43	1.16	1.11	1.64
Journeay*	27	1.24	1.25	1.61
Keesling*	37	1.26	1.23	1.53
Hall*	26	1.55	1.44	1.67
Holden*	40	1.30	1.23	1.63
Kaghazi*	35	1.38	1.31	1.70
Klondike*	35	1.42	1.25	1.84
Mayette*	44	1.33	1.22	1.44
Mayette (French grown)	54	1.25	1.18	1.41
Meylan* (Hutchinson)	37	1.47	1.30	1.45
Meylan* (Prince)	47	1.42	1.30	1.41
Milbank*	39	1.30	1.28	1.52
Mount*	45	1.17	1.18	1.21
Nebo*	32	1.47	1.39	1.59
Neff*	36	1.42	1.33	1.86
Parisienne*	36	1.41	1.30	1.52
Payne*	44	1.31	1.34	1.72
Payou*	26	1.61	1.42	2.03
Placentia*	40	1.31	1.25	1.59
Persian*	49	1.18	1.18	1.36
Pomeroy*	54	1.08	1.09	1.34
Prince*	36	1.33	1.22	1.80
Prolific	37	1.32	1.25	1.77
Rush*	45	1.27	1.17	1.33
Santa Barbara*	39	1.32	1.27	1.30
Santa Rosa*	38	1.38	1.28	1.59
Sinclair*	.....	1.31	1.28	1.45
Sorrento* (Italian)	42	1.21	1.08	1.55
Teague	50	1.23	1.17	1.37
Treyve*	37	1.34	1.22	1.45
Ward*	45	1.20	1.13	1.50
Weaver	60	1.03	1.03	1.31
Wiltz*	37	1.48	1.43	1.78

PROPAGATION.

The problem of the best way to propagate the walnut is of long standing, though for obvious reasons the present interest is greater than at any time in the past. Nearly a hundred years ago (1818) Thomas Andrew Knight, writing of the propagation of the walnut, said:

> The advantages of propagating varieties of the walnut tree by budding will, I think, be found considerable, provided the buds be taken from young or even middle-aged healthy trees: for, exclusive of the advantage of obtaining fruit from very young trees, the planter will be enabled to select not only such varieties as afford the best fruit but also such as endure best, as timber trees, the vicissitudes of our climate. In this respect some degree of difference is almost always observable in the constitution of each individual seedling tree, and this is invariably transferred with the graft or bud. * * *
>
> The buds of trees of almost every species succeed with most certainty when inserted in the shoots of the same year's growth. But the walnut tree appears to afford an exception, possibly in some measure because its buds contain within themselves in the spring all the leaves which the tree bears in the following summer, whence its annual shoots wholly cease to elongate soon after its buds unfold. All its buds of each season are also, consequently, very nearly of the same age, and long before any have acquired the proper degree of maturity for being removed the annual branches have ceased to grow longer or to produce new foliage. * * *

There are at the base of the annual shoots of the walnut and other trees, where those join the year-old wood, many minute buds which are almost concealed in the bark, and which rarely or never vegetate but in the event of the destruction of the large prominent buds which occupy the middle and opposite end of the annual wood. By inserting in each stock one of these minute buds and one of the large and prominent kind I had the pleasure to find that the minute buds took freely, whilst the large all failed without a single exception. This experiment was repeated in the summer of 1815 upon two yearling stocks [with equal success]. * * *

The most eligible situation for the insertion of buds of this species of tree and probably of others of similar habits is near the summit of the wood of the preceding year and, of course, very near the base of the annual shoot; and if buds of the small kind above mentioned be skillfully inserted in such parts of branches of rapid growth they will be found to succeed with nearly as much certainty as those of other fruit trees, provided such buds be in a more mature state than those of the stocks into which they are inserted.[1]

Later (1832) Mr. Knight said:

The walnut tree appears hitherto to have effectually baffled, under all ordinary circumstances, the art of the grafter. * * * [It] may be propagated with more success by budding. I have succeeded tolerably well in some seasons and in one season perfectly well, but in several others not a single inserted bud has been found alive in the following year, though all had been inserted with the greatest care.[2]

Mr. Knight also stated that he found the following mode of grafting perfectly successful in 1831 under many unfavorable circumstances: Allow the primary buds to unfold on both stocks and scions; then remove the opened buds, and after the small secondary or tertiary buds, which have been previously almost invisible, begin to swell, take off the scions and immediately insert upon the stocks, which should be of wood of the previous year. Saddle or cleft grafting is equally successful, though with both modes of operating it is advantageous to pare away almost all of the wood of the scion, the large pith of the young walnut in this case being of no inconvenience to the operator.[3]

The French author Berthet,[4] writing upon this topic some years ago, said:

It is noticeable that the walnut, especially when not grafted, seasons very often; that it is to say that the harvests are not equal from year to year; an abundant harvest may be followed by a very poor one.

Speaking of the importance of grafting as a means of propagating the walnut, J. B. Neff,[5] a grower of high-grade stock and originator of the Neff nut, says:

The average seedling walnut orchard is not a success for several reasons: The nuts are uneven in size and form, the trees are not equally productive

[1] Transactions of the Horticultural Society of London, ser. 1, vol. 3, 1820, pp. 133–135.
[2] Idem, ser. 2, vol. 1, 1835, pp. 214–215.
[3] Idem, pp. 215–216.
[4] Annales des l'Institut National Agronomique, sér. 2, 1897, p. 34.
[5] Personal communication.

and are largely subject to blight. It may be said that one-fourth of the trees produce a few nuts, another one-fourth produce about enough to pay the expenses of their own care, thus leaving one-half to pay such profit as may be obtained from the whole.

From this statement, which appears conservative, of the views held by one of the best-informed growers of the Pacific coast, the profits of an orchard of seedling trees are not over one-half what they should be if the trees were grafted. The profits on an orchard of grafted trees should be considerably larger if judicious care is taken in the selection of both varieties and stock. If it be true that seedling trees are more liable than grafted ones to attack by blight bacteria, it is probable that the revenue would be more than double that derived from the average seedling orchard. It must be kept in mind that there is much difference of opinion among growers and propagators as to what are the best stocks and varieties for specific localities. Much of this divergence of opinion among leading growers is due to the fact that experimentation in the propagation and improvement of the walnut in the United States is in the earliest stages.

Notwithstanding the success of Mr. Knight in budding the walnut, the method of propagating commercially has been to plant the nuts, except to a limited extent as in the Grenoble district, where the practice of grafting some of the best strains of the Mayette, Franquette, and Parisienne has been followed for some years.

The earliest walnut orchards of California were grown from nuts purchased in the open market. After these orchards began to bear it was noticed that some trees produced more and better nuts than others. Then followed a period in which the growers selected nuts from trees that were heavy bearers or that yielded a product of a higher quality, better form or color, thinner shell, or earlier maturity. This seed-selective method poduced several improved varieties, some of which should be propagated with a greater degree of certainty than is possible by seedage.

It has been found that the walnut is like the apple, the pear, the peach, and the plum; there are only two ways of propagating a variety with certainty—by budding and by grafting. Thus, it has come about after centuries of cultivation that advanced students and successful growers agree that budded or grafted trees should be used in starting a commercial orchard. Trees true to name are now propagated almost exclusively by grafting, but experiments during the past year or two by several propagators, notably Kraus, of Oregon, indicate that budding will soon take rank with if not supersede the grafting process.

STOCKS.

The two important elements in propagating the walnut true to type, variety, or name are the stock and the scion. The consensus of opinion is that the two native black walnuts, together with the rock walnut of Texas, are the stocks par excellence on which to graft the Persian walnut. The most enlightened propagators and growers recommend *Juglans rupestris* for Texas and the Southwest; *J. californica*, southern form, for the foothills and interior valleys of southern California; *J. californica*, northern form, for the coast region and interior valleys of northern California and southern Oregon, including the Umpqua Valley; *J. nigra* or *J. californica*, northern form, for the Willamette Valley in Oregon and the Columbia Valley in both Oregon and Washington; and *J. nigra* for the eastern United States. Further investigation of the merits of these stocks through extended plantings may modify these conclusions, particularly as to interior California and the Willamette and Columbia Valleys.

R. Wiltz, a propagator of considerable experience, in discussing the merits of stock for California, says:

> For our conditions in general I am convinced that the northern California black as a stock for the Persian can not be excelled. It grows 40 to 50 per cent faster than the eastern black, has a vegetative season four to six weeks longer, is inured to our conditions through ages of natural selection, is one of the deepest rooted trees that we have, is a rapid grower, has thus far been free from diseases, is exceedingly prolific under the most trying conditions, and readily accepts grafts of all strains of the Persian.[1]

Harvey C. Stiles says of *Juglans rupestris:*

> It is a very handsome tree, well worth growing for its beauty, shade, and fruit, but its great value lies in its use as a stock on which to work the English (properly Persian) varieties. * * * On that root English walnuts are succeeding in parts of California and Arizona where they failed utterly on their own roots. * * *
>
> The English walnut is very intolerant of mineral soil salts even at considerable depth and the trees, even after growing well for several years, will die back when the roots reach such soil strata. On the other hand, this *rupestris* is found almost only in a natural state on strongly mineralized soils and in hot arid regions.[2]

G. A. Schattenberg,[3] writing of the walnut industry in southwestern Texas, states that the English walnut on its own root vegetates too early in the spring for his region. He says that the future of walnut growing in Texas lies in the use of *Juglans rupestris* top-grafted, and

[1] Personal communication.

[2] Stiles, Harvey C. Walnuts in Southwest Texas. Bulletin 2, Texas Dept. of Agriculture, 1908, p. 43.

[3] Schattenberg, G. A. The Future of the Walnut Industry in Southwest Texas. Bulletin 2, Texas Dept. of Agriculture, 1908, p. 42.

that a few trees of *J. rupestris* top-grafted with the variety Franquette have made in eight years a growth of 10 feet and have borne in succession four or five crops of fine nuts without irrigation.

Since the above was written (1907) Mr. Schattenberg finds that his Persian walnut grafts on *Juglans rupestris* suffered severely in recent winters and particularly from autumn frosts. These results cast doubt on the opinions previously expressed, and the suggestion is here offered to use caution in planting the walnut in localities not fully tested.

F. T. Ramsey, Austin, Tex., says:

> Three or four years ago it occurred to us that English walnuts could be successfully and profitably grown by budding upon our native walnuts. We have been over 30 years trying to grow them upon their own roots, but have failed to obtain a nut. Four years ago we obtained direct from the woods some small trees of our native dwarf walnut, which we call *Juglans rupestris*, and after they had stood a few weeks in the nursery row we budded them. The first year we obtained a growth of about 6 inches, but since then they have grown from 3 to 6 feet each year. We now have nearly all of the California varieties, besides the Rush, Hall, and Nebo from Pennsylvania. One of these trees, Franquette, set a nut last year, but it was accidentally destroyed before maturing. We find by "ring budding" that the walnut may be propagated with ease. Thus far summer droughts and unexpected frosts have not injured a single tree. Our native walnuts vary considerably. Some trees produce a nut the size of a small marble, while others produce them half the size of an eastern black. I have been distinguishing these by the names *Juglans rupestris minor* for the small one and *J. rupestris intermedia* for the larger one. We find that the English buds will grow from two to four times as rapidly upon the former as upon the latter during the first year, so far as observed. This *minor* variety often bears a heavy crop while only 3 or 4 feet tall; the best of them can hardly be called trees, though some of them reach the height of 20 or 30 feet. I believe we will find good, profitable walnut orchards growing all over the prairies from here to Kansas.[1]

Should the expectations of Mr. Ramsey be realized by half, great value will attach to *Juglans rupestris* stock, but it must be kept in mind that these views are based on very limited experiments.

GROWING THE STOCK.

The nuts for stocks should be selected from robust, vigorous, healthy, fruitful trees of the desired species, growing under conditions that prohibit cross-pollination. After being harvested they should be layered or planted where rodents will not molest them. The method of layering will depend upon the quantity to be handled. If the quantity is small, they may be layered in the manner usually followed by nurserymen—in flats or shallow boxes easily handled by one person. If the quantity is large, lay a plank floor on the leeward side of a building with sides 6 or 8 inches high; cover the

[1] Personal correspondence, 1911.

planks with 2 inches of clean, moist sand, spread a layer of nuts, over these an inch more of sand, and continue until all the nuts are layered. On the topmost layer of sand place a light covering of straw, shavings, or leaves to prevent wash or drift, and over all stretch a fine-mesh wire netting to keep out rodents.

In the spring as soon as sprouts issue from the opening nuts they may be taken from the layering bin and planted in the nursery in the same manner as though unsprouted. As the young shoots are very brittle, extreme care must be exercised in planting; otherwise considerable or even irreparable injury results. If the ground about the nursery site is free from the depredations of rodents, the nuts should be planted at once, in regular nursery rows, upon harvesting or receiving them.

The nursery site should be high, well drained, with an open exposure and a soil that is deep, friable, and fertile without excess of humus. Unless the subsoil is thoroughly porous, the ground should be prepared by deep plowing and subsoiling. The rows should be 4 feet apart and should lie east and west, so that in the operation of budding the buds may be readily inserted on the north side. In planting the nuts they are placed about a foot apart in the row and 1 to 3 or 4 inches deep, according to the species. The small nuts of *Juglans rupestris* may be planted not more than 1½ inches deep, the larger nuts of *J. californica* and Paradox may be safely placed at 2 to 3 inches, and the still larger nuts of *J. nigra* and Royal at 3 to 4 inches. In planting nuts in the nursery rows the first stages of growth of the young trees may be facilitated by placing the nuts with their sutures in a vertical plane. As the root and shoot both issue from between the opening valves, it is readily understood how this may enable the seedling to effect an erect position almost from the moment of its germination, thereby hastening its appearance above ground and thus promoting its first stages of growth.

NURSERY TILLAGE.

Give the young trees such tillage as will insure a fine, powdery, surface soil. Care should be exercised at all times to avoid rolling clods against the young trees and thus diverting them from an erect growth, or by bruising the bark or terminal buds. If grown in a good soil thoroughly tilled, 30 to 50 per cent of the seedlings will be large enough for crown grafting the following spring. A conservative grower would discard the remainder.

SCIONS.

The scion wood should be selected with extreme care, as much or more than is accorded the selection of the stock. Only the best of

trees should be drawn upon for scion wood. Trees that are tainted with blight, that are imperfect pollinators or that mature their staminate and pistillate blossoms at separate dates, that are indifferent bearers, that are unthrifty growers, that have a sprawling irregular habit, or that are prone to fitful activity in the spring should be avoided. From suitable trees take the normal 1-year-old wood from the middle more or less erect portion. Under no circumstances use suckers, water sprouts, or trailers. Such wood rarely produces fruit, and though there is no direct evidence against it, the presumption may be advanced that it is not the best for the purpose. Scion wood should be one-fourth to three-eighths of an inch in diameter, straight, clean, thrifty, plump about the buds, tubular not angular, with short internodes and small pith, preferably not over a foot long, which is long enough, without using the terminal bud, for two or three scions. This statement is not intended to imply that wood of greater or less length than 1 foot is not suitable for grafting but rather that the kind described is ideal. Often the later growth of a season is not properly ripened; hence the frequent unfitness of terminal buds, especially on growth over a foot in length. Scions should be cut during the period of dormancy, probably two or three weeks before vegetation begins, say February or March, according to location and season. Immediately after cutting, the cut ends should be dipped into melted paraffine or other tenacious and impervious substance, so that evaporation from the cut part may not reduce the vitality of the scion. After the cut ends are waxed or smeared tie the scions in small bundles, wrap with moist moss or vegetable fiber, and put in a cool place until needed. Occasional inspection should be made to insure against attacks of fungi, such as molds, in case the temperature of the receiving space becomes too high. Another method of preserving scions practiced in California is as follows: In a box on a layer of clean moist sand 2 inches deep place a layer of scions, chink between these additional sand, then another layer of scions and more sand, and so on until the layers of scions are 2 to 3 inches deep, and cover all with 2 inches of sand and set the box away in a cool place. Occasionally examine the soil to see that it does not dry out and shrivel the buds, and on the other hand avoid moisture sufficient to start the buds prematurely.

TOOLS.

Perhaps the most important part of grafting is to have first-class tools. The knife for preparing stocks and scions, especially in trimming the cambiums, should be of the best material, so that a sharp edge may be constantly maintained. Other tools, such as a splitting

knife (which may be a heavy long-bladed butcher knife), a shoemaker's knife for nursery grafting, a budding knife of the usual form, a double-edged saw, and an oilstone with one face of emery, should likewise be of the best material. Additional tools are a mallet, two or three small wedges of iron or hard wood, a wax pot with a warming device, a wax brush, cotton cloth, twine, bicycle tape, and cloth parcel tags. The wedges should be 6 or 7 inches long and of different widths to use with branches of varying size. The shape of the taper should be such that the edges are thinner than the middle. A wedge of such form will keep its position in the cleft and may be removed readily at the close of the operation by a slight sidewise movement without disturbing the scions. A galvanized-iron pail or coal-oil can with the top cut away and four wires stretched across, two each way at right angles 8 inches from the bottom, will serve as a support for the wax pan. The space below the wires holds a gasoline blowtorch, or a fire may be built in the bottom on a layer of earth or puddled clay to keep the wax melted.

GRAFTING.

The details of methods of grafting by leading propagators differ, but not enough to be considered distinct systems. The instructions here given are adapted from George C. Payne and R. Wiltz. The principles applied to grafting deciduous fruit trees apply to the walnut, but the following precautions should be observed: (1) Great care must be exercised to have dormant wood for scions; (2) the grafting must be done just as the leaf buds of the stock are unfolding; (3) the cambium of stock and scion must be brought into exact contact; (4) the cleft in the stock for the reception of the scion shall be clean cut and so made as to grip the tongue of the scion firmly; (5) the scion shall be made from carefully selected wood with a clean, smooth-cut tongue; and (6) the wound shall be covered with adhesive wax or paste impervious to water or air[1] until the union of stock and scion is fully effected. The treatment of the wound necessitates frequent inspection in order that rewaxing may be done where cracking or melting may permit air to reach the cut surface of stock or scion. Nothing must be left undone to insure an air-tight graft and to prevent evaporation from the scion.

Numerous modes of grafting and budding have been employed with the walnut and among the more successful are cleft, saddle, whip-and-tongue grafting; annular, flute, prong, shield, and chip budding.

[1] In the walnut-grafting operations at the Arlington Experimental Farm in the spring of 1912, plasticine or modeling clay was used with excellent results. In fact, a larger percentage of successful grafts was obtained with plasticine than with wax, as the former does not dry and crack like the latter.

The time for grafting is just as the trees begin to vegetate, or while the leaves are unfolding. If top-working the Persian walnut, it is advisable to begin operation somewhat earlier than if grafting the black-walnut stock, as the former has a more abundant sap flow during the first few days of vegetative activity. It is possible to successfully graft the black walnut after the leaves have quite fully unfolded, while best results with the Persian stock are obtained by grafting just as the buds are fully swollen. The grafting of nursery stock is attended with variable results. In some years propagators are widely successful, during other seasons only a few obtain favorable results. No satisfactory explanation has been made for this uncertainty, though most propagators ascribe it to seasonal conditions and to lack of specific information for the problems in hand. The operator should avoid bleeding nursery stock by grafting as soon as possible after the slipping of the bark and discontinue before the sap becomes free flowing. Budding may be done at any time when the bark will slip readily and when well-formed dormant buds can be procured.

FIG. 1.—Cleft grafting: First position of the knife when making a cut.

The following directions for cleft grafting will apply in all essentials to the other modes of grafting: Prepare the stock which, preferably, should be not more than 2 or 3 inches in diameter, by making a smooth, clean-cut surface. In top-working old or large trees it is often desirable to graft limbs of a diameter larger than 3 inches, in which case additional care must be exercised in the operation and more scions set in each stock. In sawing off the stock use great care not to split the bark. If the stock to be sawed off is a substantial branch of a full-grown tree the same care must be given as in pruning; otherwise back splitting will

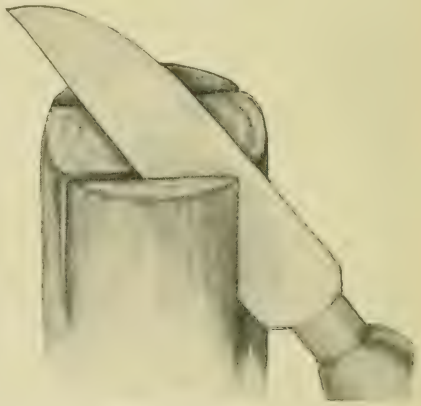

FIG. 2.—Cleft grafting: Second position of the knife when making a cut.

occur, with great inconvenience to the operator and damage to the tree. To avoid back splitting, follow the directions for removing large branches in pruning (p. 83). After the stock is prepared, split it along two lines (figs. 1 and 2), using care to keep the knife in the positions shown, so that as it is driven into the stock it will cut the bark first; if the stock is large, split it along four lines (fig. 3).

After the bark has been split 1½ to 2 inches deep on both sides of the stock, change the knife to the third position (fig. 4) and complete the cleft.

If a horizontal branch is to be grafted make the cleft crosswise rather than vertical, so that the scion may be inserted on the side. Scions inserted upon the upper face of a branch rarely grow, while those on the sides do quite as well as when placed upon vertical branches. After removing the knife insert a small wedge to hold the cleft open until the edges can be smoothly dressed and the scions inserted (fig. 3).

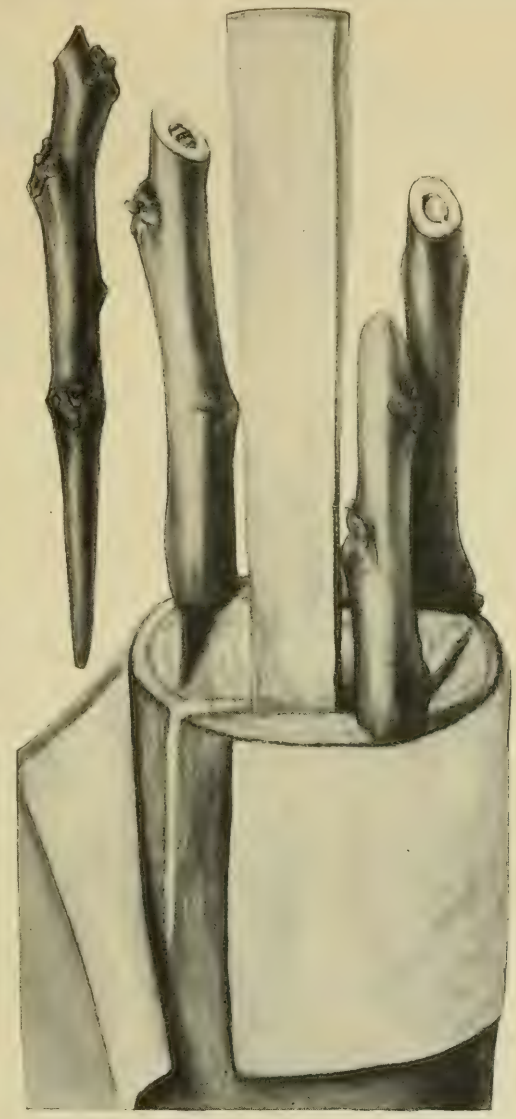

FIG. 3.—Cleft grafting: Large stock of Persian walnut split to receive four scions. The clefts are not made entirely across the stock; i. e., each split is made from one side only.

PREPARING THE SCION.

If the scion wood has been properly selected it will be an easy matter to make two or three suitable two-bud scions from each of the sticks of scion wood. Where the wood is not uniformly good, select only that which has little pith, strong but not large buds, and firm wood. The lower end of

the scion should be 1½ to 2 inches below the lower bud, the upper end one-fourth to three-eighths of an inch above the second bud of the scion. The tongue of the scion should be about 1½ inches in length, of an easy, straight taper, and with the outside somewhat thicker than the inside (figs. 5 and 6). In placing the scions use the utmost care to have the tongue of the scion fit the cleft snugly, and so placed that the cut edges of the inner bark of both stock and scion come in contact over as long a space as possible. On removal of the wedge the cleft will firmly grip the scion and safely hold it till the operation is complete. The final step is to wrap the stock firmly with a cotton band (fig. 7) 3 or 4 inches wide and to cover with wax the entire wounded surfaces of both stock and scions, including all breaks in the bark at the base of the cleft. If the cleft remains widely open after the wedges are removed the space may be choked with old newspaper or similar material before the stock is waxed over. This packing should be pushed below the cut surface of the stock so that waxing will leave no breaks whereby air may enter. After waxing is complete (fig. 8) draw over the whole a paper bag (fig. 9) and tie it firmly about the stock a few inches below the lowest point of the cleft. When the scions indicate that union has taken place, the cotton band may be

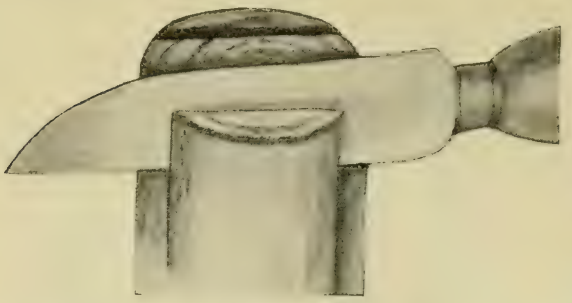

FIG. 4.—Cleft grafting: Third position of the knife when making a cut.

FIG. 5.—Cleft grafting: Scion prepared for insertion.

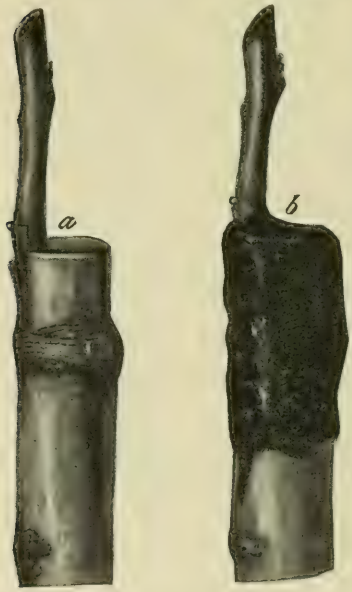

FIG. 6.—Cleft grafting: *a*, Scion inserted in the cleft; *b*, the completed graft wrapped and waxed.

cut through at one or two places to prevent restricting the circulation of sap. The other modes of grafting differ from the above only in minor details (figs. 10 and 11).

CARE OF THE GRAFT.

It is necessary in grafting and budding that no air reach the cambium of either scion or stock. Frequent inspection of grafts should be made and all pores and cracks rewaxed. If the waxing was well done at the start and the paper bags carefully adjusted and firmly tied it is not likely that much rewaxing will be needed. As soon as the grafts are nicely started the bags may be broken open, preferably on the north side, so that light may be admitted. In a few days thereafter the bags may be entirely removed.

FIG. 7.—Grafted stock wrapped with a plain or waxed cotton band.

As soon as the grafts are well established provision must be made for supporting them against winds. For this purpose strips of lumber 1 by 2 inches are firmly nailed to the stock in such positions as will permit of tying the young growth to them. As the growth of grafts, especially when placed upon large and vigorous stocks, is very strong, these supports need to be from 8 to 12 feet long in order to give the desired protection (fig. 12). The grafts should be tied with strong soft cord or cloth bands in such a way as to prevent rubbing. During this time all sprouts nearer the grafts than 2 feet must be kept pruned off. Only in the case of grafts that have failed to take should sprouts be allowed to grow near the point of grafting. In this case one or two such sprouts may be used for budding, thus enabling the operator later in the season to make a second attempt at propagation.

FIG. 8.—Completed cleft graft covered with wax.

BUDDING.

Thus far budding has been practiced only by amateurs. More or less experimenting was done the past decade and few propagators

found it commercially useful, but with the rapid spread of the idea that only grafted or budded trees should be planted for orchards came a corresponding growth of interest in budding. Several persons investigating independently within the past two years have produced excellent results from carefully selected buds, modifying in several respects the methods usually adopted in budding (figs. 13 and 14.) While not sanguine enough to publish results, some experimenters believe that we are soon to witness a decided change in the method of budding, which will displace, especially in nursery propagation, the present unsatisfactory practice of crown grafting. During 1910 less than 20 per cent of the nursery grafts effected successful union, and in a few instances propagators who had formerly secured as high as 50 to 60 per cent of unions were rewarded with less than 10 per cent. The low percentage of "takes," together with the heavy expense of operation in crown grafting, makes it desirable to adopt another method.

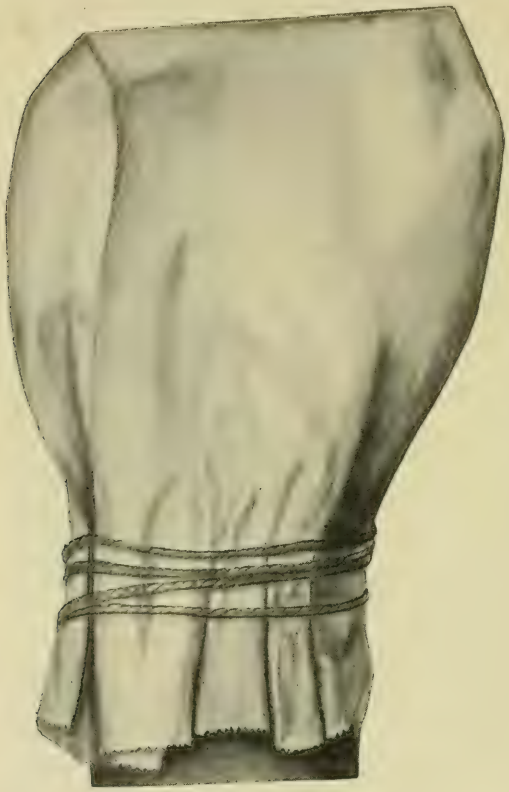

FIG. 9.—Completed cleft graft covered with a strong paper bag to protect it from evaporation. This bag should be removed when the scions have made considerable growth.

To stimulate experiment along this line, attention is called to a few points found useful last year. One worker found that the use of dormant buds upon the present year's growth during July resulted favorably. He adopted the usual method of budding, but made the crosscut at the bottom instead of at the top of the slit. Another recommends chip budding (fig. 15), with bicycle tape[1] for wrapping material. This operator finds it necessary to use buds that are fully dormant, preferably those which have been

[1] Bicycle tape gave very unsatisfactory results in budding operations at the Arlington Experimental Farm in 1912.

kept in cold storage, but if such buds are not available, then use secondary or tertiary buds formed early on the present season's growth. Some propagators recommend plate budding (fig. 16), and exhibit highly satisfactory work done by this method. One propagator working by this method selects stocks 1 to 1½ inches or even larger in diameter and takes buds from stocks, shoots, or branches that are one-half to three-fourths of an inch in diameter. He recommends that the operation be performed as late as possible to get a good flow of sap when the weather is cooler (an important factor); growth for the season is about completed, and the wrapping used may remain on all winter. Prong budding (fig. 17) was highly recommended by the late B. M. Lelong, of California, and is strongly indorsed by a few skillful workers on the Pacific coast. In all these instances the prime requisite appears to be the dormancy of the bud followed by close wrapping and sealing to protect the wound from the air.

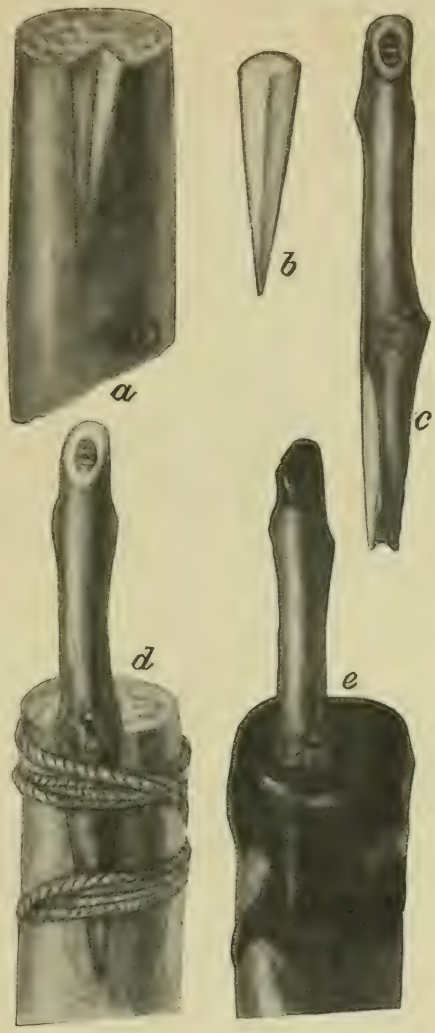

FIG. 10.—Modified wedge grafting: *a*, Stock with wedge removed; *b*, wedge to be discarded; *c*, scion with lower end shaped to replace discarded wedge; *d*, scion fitted into stock and wrapped with cotton twine; *e*, completed graft with wax covering.

Recently E. J. Kraus,[1] of the Oregon Experiment Station, as a result of extensive experiments in budding the walnut, states in substance that the method of budding consists in the combination of the old principles adapted to new subjects and conditions. By this method with good buds, 1-year-old seedlings, and the exercise of ordinary care, 70 to 90 per cent of the buds should take and form satisfactory trees.

[1] Circular 16, Oregon Agricultural Experiment Station, 1911, p. 3.

Briefly stated, Kraus's instructions for accomplishing such results in Oregon are as follows:

The best stock was the California black; the hybrids were found to be not dependable; buds of the present season's growth were found to be unsatisfactory for several reasons; plump buds 1 year old were found best. These may be taken from the base of the current year's growth or from scion wood cut during the winter and kept fully dormant. Such bud wood should be placed in moist sand about two weeks before budding is to be done. The T and inverted T methods were found unsatisfactory, and the hinge and flute bud were used. Special care is needed in the wrapping and waxing to see that it is pressed firmly against the wood of the stock and that the air is excluded; tie the buds into place with raffia, then cover with waxed cloth; if budding is done in hot weather it is desirable to tie a paper sack over the bud for protection; in about 10 days remove the wax and this outer protection; about a week later cut the raffia band; use care to see that the raffia is neither left too long on fast-growing stocks or cut before the bud has united firmly.

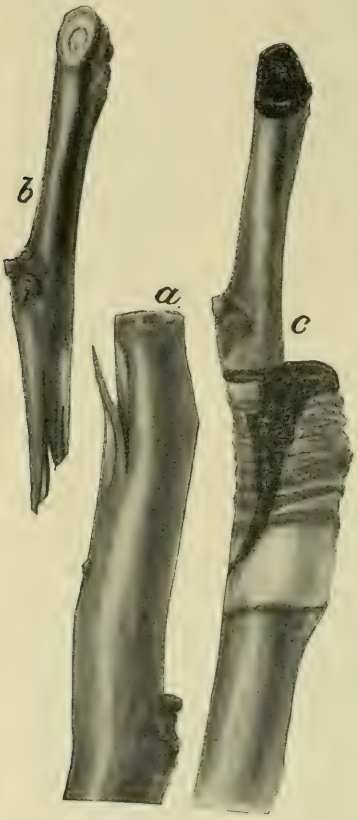

FIG. 11.—Modified whip grafting: *a*, Stock prepared to receive scion; *b*, scion with lower end shaped to fit into stock as prepared; *c*, scion fitted and held in place by twine wrapping and protected by wax covering.

The following details as to the method of hinge budding and pushing the bud under protection are distinctly different from those given by the older authors:

Making the bud.—About 1 inch above the surface of the soil make a transverse incision about half an inch long, and a similar one about three-fourths of an inch above this. Connect the two with a longitudinal incision. This forms the completed I cut on the stock. It is very desirable to use extra care in making these cuts. The ideal condition is to merely penetrate the bark just to the wood but not to cut into it. The bud, which is rectangular and of exactly the same length as the distance between the two transverse cuts on the stock, is removed from the bud stick by first making two transverse cuts the proper distance apart to give the correct length to the bud, and then connecting these with two longitudinal cuts about half an inch apart. The bud is then easily removed by gently inserting the back of the knife blade under one corner of the piece of bark and prying up, when it will be found that it will readily part from the bud stick. No wood should be removed with the bud and care should be taken when the bud proper is extra large to avoid pulling the soft wood or core out of it. It may be necessary in such a case to first loosen the bark containing the bud on one side up to the bud proper, then carefully cut this soft core with a knife, and

the remainder of the bud piece may be easily removed. As soon as the bud is removed from the bud stick it should be immediately inserted into the stock. This is readily accomplished by first carefully turning back the upper corners of the I-shaped cup, slightly prying them away from the wood, then inserting the base of the bud into the opening, pushing it down until the top and bottom of the bud are flush with the transverse cuts on the stock, and the bud lies smoothly and snugly against the latter. By making the bud force its own passage under the bark of the stock after this manner there is much less exposure to the air than if the sides of the cut are first turned back and the bud then laid in place. The bud is now ready for tying and waxing as explained below.

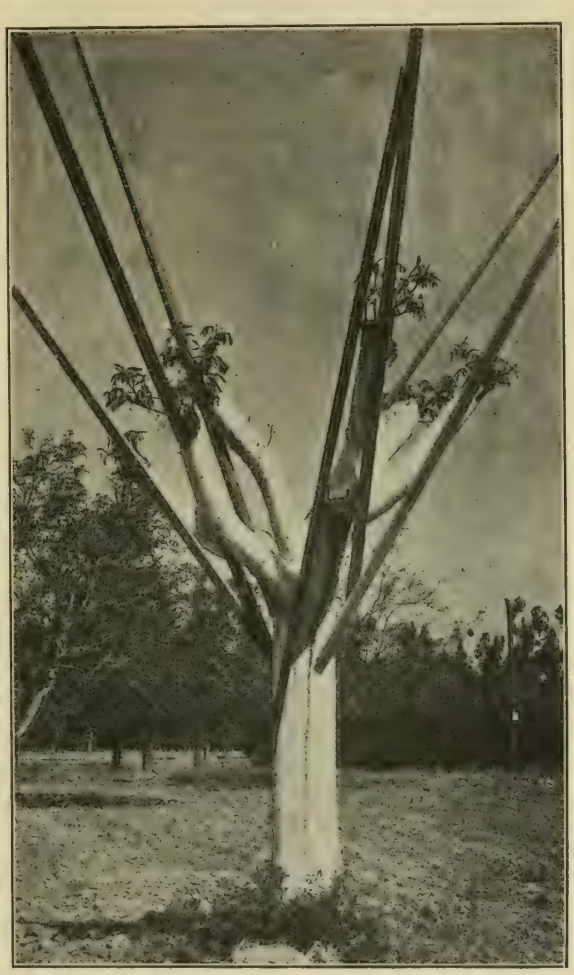

FIG. 12.—Stays applied to a top-worked walnut tree to prevent the growing grafts from being blown away or broken off by their own weight. (Photographed by J. B. Neff.)

Starting the bud into growth.—If the budding has been done in June or earlier and the buds are to be started into growth the same year, the trees should be headed off at the time the raffia is removed, about 15 days after the budding. Cut off the stock about 1½ to 2 inches above the bud, allowing the top to remain attached at one side by a small piece of wood or bark. These tops should then be broken over and laid overlapping each other in the row, thus providing shade to the buds and aiding in the carrying off of excess sap and preventing to a considerable degree an excessive sprouting from the root. In about two weeks the scion bud will have started into active growth. The top of the stock should then be removed entirely, close to the bud. In sections subject to high winds the young shoots should be staked. See that all buds and shoots from the stock are taken off, as they are a material drain on the reserve food supply in the stock.

If the budding has been done late in the season so that the trees can not be headed back before August 1, such heading back had best be deferred until the following spring just about the time that growth starts. There is some

danger of the buds being killed during the winter or injured by excessive wet weather. It is therefore preferable in such cases to put the buds somewhat higher on the stock than when the trees are to be headed back in June or July. Trees coming from stock headed back about the middle of June to the first week in July will make from 14 to 20 inches' growth the same season and usually mature thoroughly, so there is no danger of killing back during the winter. Such young trees could be put on the market the winter following the budding. Trees from stock that has been headed back in the spring will make a straight growth of 5 to 7 feet during the season.

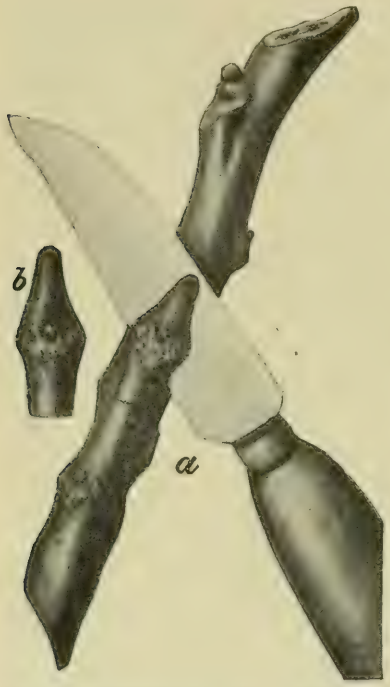

FIG. 13.—Budding by the T, shield, or slip process: *a*, Cutting the bud from the bud stick; *b*, the bud after removal.

WAXES.

The following recipes for waxes are substantially from the several propagators cited:

Beeswax 1 pound, rosin 5 pounds, flaxseed 1 pint, lampblack 1 ounce; melt the mixture. The object is to get a wax that is soft enough to be pliable without running; a little practice will soon show whether the wax needs more or less oil.—*J. B. Neff.*

Rosin 4 parts, beeswax 2 parts, tallow 1 part. Cut the materials up into small pieces, mix well, and boil for several minutes. Dip the hands in linseed oil before using this wax.—*Wright, a Texas grower.*

Linseed oil 1½ pounds, beeswax 1½ pounds, rosin 9 pounds; or, linseed oil 1 pound, beeswax 2 pounds, rosin 9 pounds. Tallow would answer in place of the oil, but the oil is better. Heat over a slow fire until all materials are fully melted and unified, but do not boil.—*R. Wiltz.*

Rosin 5 pounds, beeswax 1 pound, finely pulverized charcoal one-half pound, raw linseed oil 1 gill. Melt the rosin and beeswax over a slow fire, then stir in the charcoal, add the oil, and pour into pans that have been previously oiled with linseed oil so that the wax will not stick.—*G. C. Payne.*

PLANTING, TRAINING, AND PRUNING.

The leading problem with every orchardist is, What are the best varieties to plant? While preferred varieties may be indicated, selection in each instance must depend upon the judgment of the individual. Upon this point some light may be shed by the remark of one of California's foremost students of the walnut. When asked, "What varieties are best for me to plant?" he said: "I do not know. If you will come to my home I will show you what I

have done, give you the whole story, and then you can draw your own conclusions." Those who contemplate planting walnut orchards will do well to visit the successful growers of the district where they contemplate planting. Within tentative boundaries the types that have given and promise to give the most favorable and certain returns are here indicated.

For the southern California region the six blight-resistant varieties suggested by the University of California:[1] Chase, Concord, Eureka, Franquette, Mayette, and Wiltz, though the Franquette is affected by blight in some districts. The Franquette and Mayette have been tried to a limited extent in southern California but so far as reported with rather indifferent results.

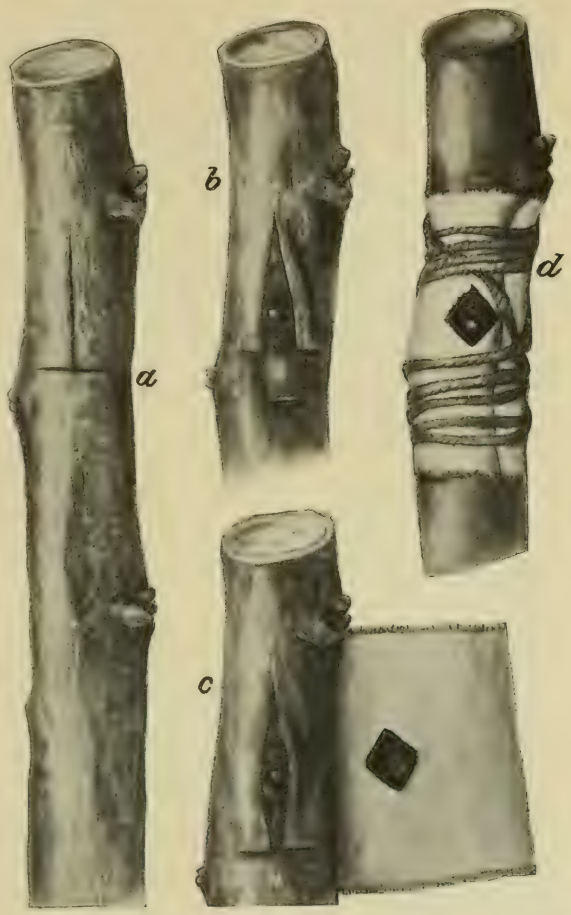

FIG. 14.—Steps in the process of T, shield, or slip budding: *a*, Stock with inverted T-shaped slits in bark prepared to receive bud; *b*, same with bud being slipped into place; *c*, bud in place ready to be wrapped; *d*, bud showing through cut in wrapper when process is complete.

For northern California: Concord, Franquette, Mayette, Meylan, Wiltz, and possibly Parisienne and Treyve, though Mr. Hitchinson, the only grower of Treyve, reports that it is late in coming into bearing and yields light crops—two serious faults. The Eureka is also urged by some observers as especially worthy of trial in this district.

For western Oregon and Washington: Franquette and Mayette are the only varieties yet given extended trial, but Concord, Meylan, Parisienne, Treyve, and Wiltz are well worth general testing in an

[1] Bulletin 203, California Agricultural Experiment Station.

experimental way. Of Concord, Groner says: "This variety is too late for our environment."

For the Eastern States: Only one variety, the Pomeroy, has been generally disseminated. As a seedling it has been given a thorough trial. It is apparently suited to the climate of the more favorable sections of the Eastern States and will undoubtedly yield a more uniform product and better results when worked upon the eastern black walnut. The Nebo and Rush varieties, recent introductions which promise well, are being worked on native stock, and are the only eastern varieties of which grafted trees are offered for sale at present, though others will probably be offered in 1913. A few other varieties give promise of meeting local requirements for a hardy, productive, marketable nut of fair quality, notably Cumberland, Holden, Milbank, Mount, and Sinclair. Trees of the Bijou type have proved in several instances to be hardy and good croppers, but the nut, though suitable for home use, is not considered of commercial importance. It is expected that experiments under way will in a short time demonstrate the fitness of some of the hardier European strains, particularly when top-worked upon the native black walnut.

FIG. 15.—Steps in the process of chip budding: *a*, Bud stick with bud partly removed; *b*, stock with bud removed and discarded, ready to receive new bud; *c*, new chip bud from bud stick in place on stock; *d*, bud wrapped as it appears when operation is complete.

POLLINATION.

Before deciding what varieties to plant, ample pollination must be assured, as otherwise generous crops can not be produced. The walnut normally produces two kinds of blossoms: The staminate, commonly spoken of as the catkins, and the pistillate, usually called nutlets (fig. 18, *a* and *b*). This arrangement of the sex organs on two separate parts of the plant, together with the peculiar structure of the flower, necessitates the employment of an outside agency—the wind—to insure pollination. The staminate blossoms, when open, are much expanded (fig. 19, *a*) and heavily charged with dustlike pollen released from little sacs (the anthers) and blown upon the stigmas of the pistils (fig. 18, *d*), thereby effecting fertilization. Not infre-

quently these two kinds of blossoms (staminate and pistillate) do not mature at the same time upon the same tree, or one or the other of them is infertile because of imperfect development; such tree, if by itself, is unproductive. The Los Angeles or Mission walnut, when planted in the northwestern Pacific region, persistently fails to fruit for one or other of these reasons, though occasionally failure is chargeable to late frosts.

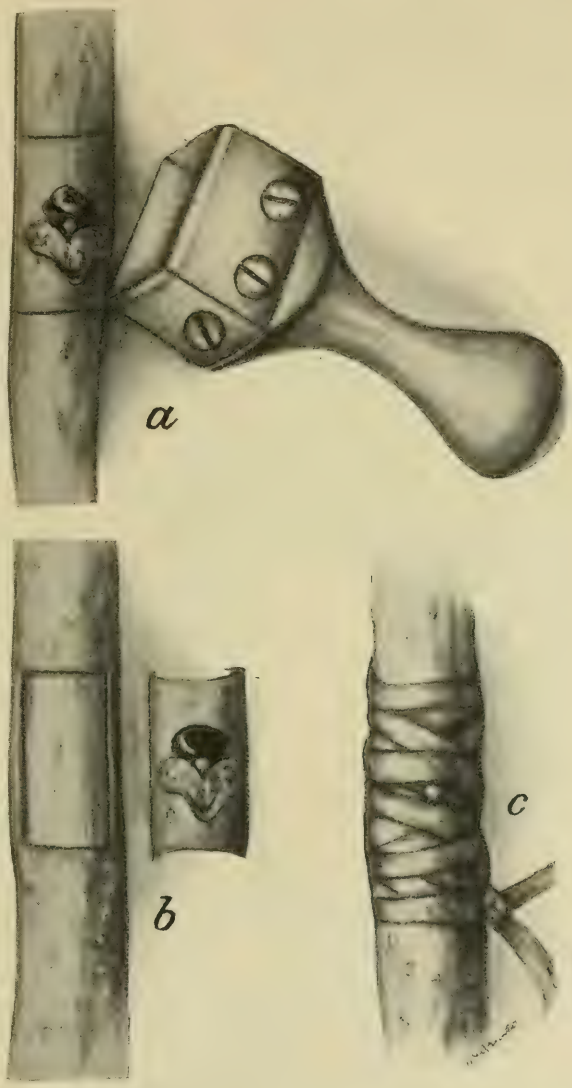

FIG. 16.—Plate or partial ring budding: *a*, Bud stick showing bud marked for removal by special tool used for the purpose; *b*, stock with patch of bark removed and discarded ready to receive new bud; *c*, new bud in place and wrapped with raffia, completing the process.

To insure complete fertilization care should be exercised in the selection of varieties. Where little definite information about pollination and fertilization is available it is safe to plant two or more varieties which blossom at the same time. In some instances of shy bearing it may be desirable to introduce a variety rich in pollen, regardless of the character of its nuts, in order to amply fertilize the blossoms of the more valuable varieties. To insure effective pollination one tree in seven when planted in quincunx and one in six when planted in squares is deemed sufficient, except possibly where prevailing winds are strong and persistent from one direction. Many

American growers are of the opinion that future orchardists will make provision for insuring a high percentage of fertilization by mixing varieties. Until ample investigation has been made it is safe to plant only varieties of known value as pollinizers, leaving the work of testing varieties not so well known to the State or Nation, except as the enthusiastic amateur finds it advantageous to make trials of promising new varieties.

So far as recorded by American growers only two varieties, the Santa Barbara and the Franquette, have been planted in pure stands of any considerable area. With these two varieties crop shortage appears not to be due to insufficient pollination, but no definite experiments have been performed to ascertain whether better results might be obtained if opportunity for cross-pollination were afforded. California growers after many years of experience consider the crop better in those orchards where more than one variety is grown. In the case of the Santa Barbara the type, vigor, and individuality of the trees vary as widely as several different varieties ordinarily do, insuring nearly as active cross-pollination. Briefly, then, it may be stated that while good crops may be secured from tracts planted to single varieties, especially if free blossoming with catkins and nutlets at the same time, progressive growers advise mixed plantings of two or three varieties of similar merit, keeping in view that they should be equally well adapted to the location and blossom at the same time in order to insure effective pollination.

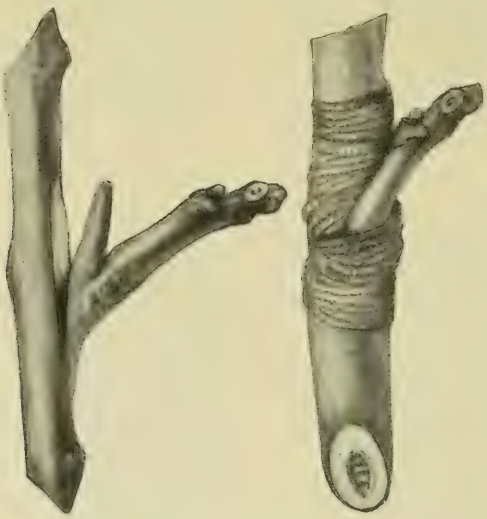

FIG. 17.—First and last steps in the process of prong budding or prong grafting.

PLANTING.

The walnut is planted as early in spring as the soil permits, care being exercised to avoid puddling when the ground is too wet. The distance between trees varies from 40 to 60 feet each way, requiring 12 to 27 trees to the acre. Some growers recommend planting trees in the center of the squares made by the first alignment, such trees to be removed as soon as those in the regular rows require the space for their development. It is asserted that the increase of product,

if grafted trees are planted, will pay a liberal profit upon the additional cost involved in the purchase and planting of the extra trees.

FIG. 18.—Young shoot of Persian walnut with a piece of the previous year's growth, showing staminate and pistillate flowers in situ: *a*, Pistillate flowers; *b*, the same enlarged; *c*, staminate flowers; *d*, portion of same enlarged.

Only deep, rich, well-watered soil should be used for growing a walnut orchard, and the filler trees should be removed as soon as the regular trees are 16 to 20 years old.

Formerly much difference of opinion existed as to the age at which trees should be transplanted from the nursery, but recent practice favors 1-year-old trees that have been grafted on stocks 1 or 2 years old. Such trees average 4½ to 6 feet in height and an inch, more or less, in diameter 1 foot above the union of the stock and scion and may be taken from the nursery with a larger root system than when older. Since trees at this age will be unbranched, the grower will be able to adjust the branches that form the head to much greater advantage than if transplanting is delayed until after branches have formed in the nursery. The walnut does not suffer so much from malformed heads as some other deciduous orchard trees, but a well-formed head is desirable if vigorous and long-lived trees are to be grown.

FIG. 19.—Sexual organs of the Persian walnut: *a*, Matured catkin; *b*, fertilized, unblighted nutlets; *c*, blighted nutlets of the same age.

The details of planting are quite the same as for other orchard trees. Keep the roots from air as much as possible between nursery and orchard. Prune off all bruised and broken roots with a clean, smooth, oblique cut. If possible to obtain trees from the nursery in the autumn preceding planting, root pruning may then be done advantageously before the trees are heeled in, and the wounds will be callused before planting time. The growth of the new rootlets can then proceed more quickly at the opening of the season. In recent years much discussion has arisen over the importance of the taproot. It is safe to say that healthy vigorous trees with a good supply of lateral roots and a short piece of taproot will make as good development as one with a longer taproot. The removal of the taproot is not

prohibitive of the success of transplanted trees, especially if they are not more than 2 years of age.

TRAINING.

The subsequent treatment of the young tree will depend upon the end to be attained. If the head is to be formed high the tree must not be cut back, but must be supported in an erect position by a tall, strong stake 2 by 3 inches in cross section and 8 feet long (fig. 20). If it is decided to form a low head the top may be cut back to 4 or 5 feet and a short stake driven to hold the stock upright until the branches are well formed and the trunk of sufficient strength to support the head. When the young branches have issued a few inches the trees should be examined and only those shoots permitted to grow that will help to form a strong, symmetrical head. The young main branches allowed to grow should issue 9 to 12 inches apart on the trunk and be so supported, if need be, that they will grow obliquely upward. After the 3 or 4 main branches have become fixed in the desired positions little remains to be done in training or pruning except to remove the sprawling growth from the lower side of the outspreading branches and such wood as threatens to rub, interlace, or unduly crowd (fig. 21).

FIG. 20.—Young walnut tree staked and tied—a general practice with high-headed trees in Oregon.

In sections where the summer heat is not too intense the walnut should be pruned to present an open, spreading head, facilitating the formation of bearing wood throughout the top rather than on the outer portions, as is usual with dense heads. Where the summer temperature rises to 110° or higher it is necessary to train close or dense heads to protect the nuts from sunburn, which darkens the kernel and lessens the market value.

It was formerly the practice to head the trees 6 to 9 feet high, but now many start the heads at 4 to 5 feet. In pruning and training during the first few years this lowness of branching is of considerable advantage. The fact that the walnut tree is wide spreading has led many to suppose it necessary to head high in order to facilitate tillage and harvesting beneath the branches. By proper training the head may be started low and the branches still be kept well out of the way. (See frontispiece.)

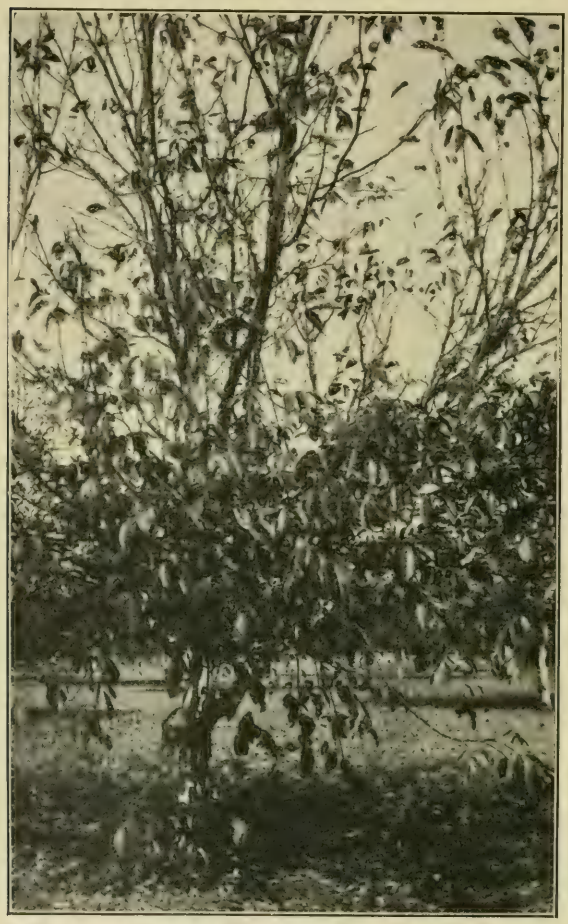

FIG. 21.—Unpruned Persian walnut tree with an abundance of trailers.

Low spreading branches and close heads favor blight, while high open heads permit free circulation of air and penetration of sunlight which are unfavorable to the development of blight Low heading at 4 to 5 feet does not necessarily imply that the tops shall be low. They may be quite as high and open as though the heads were started at 7 to 9 feet from the ground. In the first instance pruning, forming the head, and training the branches can be performed more effectively, with a saving of both time and labor. The importance of the proper structure of the head does not usually appear until heavily laden mature trees are wrecked by an autumn storm.

Little pruning and less training has been done in the past, but more attention is now given to these matters. Growers are studying the young trees in newly planted orchards and are debating how to stimulate growth, increase the yield, and lessen the effects of blight

by judicious pruning. Specific treatments are being tested, such as thinning out the centers of the tops, lifting the outspreading portion of the head by pruning off the lower limbs, and in some instances removing lateral branches, all insuring the tree more light and air, and a better distribution of bearing wood.

As the area of cultivation becomes extended and the varieties under cultivation are augmented by the addition of types developed to meet local conditions, which are practically numberless, it is certain that extended and varied practices in pruning and training will be evolved.

PRUNING.

The walnut actually requires very little pruning. Root pruning and cutting back attendant upon planting have been referred to under training; such other pruning as is found necessary or desirable to keep the tree in form for the best results should be done during the resting period and at least two or three weeks before the starting of the sap in spring, so as to permit the wounds to become dry and to prevent bleeding and a tardy healing of the wound. If close attention is accorded the tree in all matters pertaining to its proper training it will rarely be found necessary to remove other than small branches. Should it become imperative through accident, oversight, or other contingency to take off a large branch, care should be exercised to prevent the splitting or tearing of the part remaining.

The removal of a large limb may be best effected by cutting it off in sections. In order to prevent back splitting, bruising, or crushing make a deep saw cut on the under side of the limb some distance out, then upon cutting into it from the upper side a few inches farther out the limb will break short off. Another operation will dispose of the stub and leave a clean-cut surface close to the main body. In any event make the final cut so that no projecting stub is left.

Upon the removal of any branch over an inch in diameter cover the wounded surface with quick-drying adhesive paint, such as a good quality of white lead and linseed oil, in order to keep the surface dry and prevent the attacks of fungi. This paint will be of greater efficacy if the wound is first brushed with a strong solution of one part of copper sulphate to three parts of water. From time to time go over the orchard with a paint pot and brush and renew the covering on these wounds to prevent fungi from obtaining a foothold.

During the first few years of growth of the walnut it is prone to develop many drooping shoots from the lower branches. These are often used for bud or scion wood, but the practice is to be deprecated. Such shoots rarely if ever bear on the parent tree and it is possible

that the continued use of such wood may induce a habit of drooping growth and transmit barrenness. Until investigation definitely disproves the idea it is safe to avoid such practice.

CULTIVATION OF THE ORCHARD.

Clean tillage is the almost universal practice, except as to cover and truck crops. Cover crops are coming into general use for blanket and humus purposes and truck crops are grown among young trees. In the large orchards of southern California where clean tillage has been practiced 15 or 20 years the soils are becoming less tractable because although tons of leaves fall upon the ground in the autumn only a small proportion of them become incorporated with the soil. They blow away from the smooth surface of the orchard floor into ditches, fence rows, and hedges and are largely lost to the orchard area. Cover crops are useful to hold these leaves in place as well as to furnish humus and to prevent wash from winter rains. With cover crops, the first operation in the spring is to plow under such crops to a depth of 6 or 7 inches. This operation may be followed at once with a spike or spring tooth harrow and then with a roller or clod masher if the condition of the soil demands it. This first or spring preparation of the soil should be followed by frequent scarifyings, once every 10 days or 2 weeks, to kill weeds and to convert the surface into a dust mulch to better conserve the water supply. These operations are usually performed by riding cultivators with broad-winged shovels or with an implement known in California as a scarifier, having broad blades set obliquely to the line of draft, each one partly overlapping the course of the one ahead of it (fig. 22). From years of experience many of the large California growers in districts where the annual rainfall is over 24 inches are convinced that it is better to maintain a thorough dust mulch throughout the growing season than to irrigate, though frequently one application of water about two weeks before the nuts begin to fall is of service in causing them to separate more readily from the hulls.

FIG. 22.—A harrow used by California cultivators to produce the dust mulch much employed in the groves of that State.

IRRIGATION.

The details of irrigation are much the same as for orchards of other deciduous trees. The site, soil, location, and season are in each instance governing factors. Present irrigation of the walnut is confined to the section of California south of Ventura and to the interior valleys. The furrow system is generally used in orchards where the soil is heavy and the basin system where the soils are light. In districts where a mild climate will permit and the soil is deep and retentive, winter irrigation may be practiced with decided benefit.[1] Where the rainfall is 17 to 23 inches two applications of water are advised, one in February and one in May. In very dry seasons a third application before harvesting is desirable to prevent the hulls clinging to the shells. Possibly the machine huller will be more economical than an application of water.

COVER CROPS.

Some years ago several growers in southern California noted that the nuts from the older orchards were averaging smaller, one year with another, than those from young trees. Experiments with a few trees and in one instance with a large orchard, that of John F. More, of Goleta, showed frequent applications of cover crops to be of decided benefit to old orchards. It is becoming apparent to owners that provision must be made to supply plant food to the soil if the trees are to maintain the crop standard in quality and quantity.

The selection of a cover crop will depend upon the location. Mr. More found barley and volunteer plants sufficient; others find it desirable to use some leguminous plant to obtain nitrogen. In the Pacific Northwest vetches will probably give the best returns. If the land is well supplied with nitrogen and needs only humus and a protection from beating rains or wash, then any of the winter-growing crops like mustard, wheat, rye, or winter oats will serve the purpose. In parts of California vetches, winter and hairy, fenugreek, Canada field peas, bur clover, sweet clover, and volunteer plants such as alfilaria, mustard, and others are available.

As to the expense and management of cover crops the following by Samuel Fortier[2] is especially pertinent:

> In the walnut groves of Orange County, Cal., bur clover is sown in the fall, given one or two irrigations during the winter if the rainfall is below the normal, and plowed under in April.
>
> The cost of such cover crops as peas, vetch, or clover includes the seed, the labor of sowing it, the water, and the time required to apply it. These items, according to Dr. S. S. Twombly, of Fullerton, Cal., amount to $2.50 to $3.25 per acre. Twenty tons per acre of green material is perhaps an average crop. In this tonnage there would be about 160 pounds of nitrogen, which at 20 cents per pound represents a value of $32 per acre for a cover crop like vetch.

[1] Irrigation of Orchards. Farmers' Bulletin 404, U. S. Dept. of Agriculture. 1910.
[2] Idem, p. 35.

FERTILIZERS.

The question of fertilizers for the walnut orchard is one that has not yet attracted wide attention. In recent years owners of old orchards have found some form of manure necessary to insure thrifty growth and a substantial crop. While cover crops are desirable and serve to ameliorate and improve the soil and increase its fertility, something more appears to be needed in soils long covered with bearing orchards.

In France, where the problem is of long standing, Fallot cites Rouault's formula [1] as approximating its own calculations for a chemical fertilizer suitable for walnut culture, as follows:

Nitrate of soda containing 15 per cent of nitrogen, 78 pounds; superphosphate containing 12 per cent of phosphoric acid, 16 pounds; and chlorid of potassium containing 48 per cent of potash, 6 pounds; total, 100 pounds.

In the article cited M. Rouault [1] says:

> Now, are not these three substances most appropriate to the soils and to the needs of vegetation? Would it not be an advantage also to adopt a manure mixed of farm manure and chemical substances in a manner to give it a composition approaching that which I have indicated?

After making numerous analyses of the walnut and an extended study of the soils of France, Fallot [2] states:

> The walnut is rich in nitrogen and contains considerable proportions of phosphoric acid and potash. In regions where intensive culture has been adopted it will be an advantage to use fertilizers containing nitrogen, phosphorus, and potash in proportions varying with the needs of the tree; that is, depending on the quantities of fertilizing elements which the tree removes from the soil and does not restore. As regards the walnut, the fruit alone takes out these elements; one can neglect the small proportions remaining in the wood, and the leaves in general return to the soil either directly or after having been utilized as litter.

While Fallot says that the French walnut is especially rich in nitrogen and makes the composition of the whole nut nitrogen 2.66 pounds, phosphoric acid 0.75 pound, potassium 0.79 pound, analyses by G. E. Colby, of the University of California, give nitrogen 0.54 pound, phosphoric acid 0.15 pound, potassium 0.82 pound and show it rich in potash rather than in nitrogen.

The problem of fertilizers is complex. It is no longer held to be simply a matter of returning to the soil what the crop takes out, or of supplying those substances that analysis shows to be wanting in the soil. A half score of other factors as important as these enter into the problem of how to feed the orchard. A knowledge of the composition of soil and crop is valuable, and even more so

[1] Rouault, M. F. Le noyer, recherches destinés à guider dans la composition des engrais qu'on lui destine. Grenoble, 1891. [Cited by B. Fallot.]

[2] Fallot, B. Culture du noyer. Journal d'Agriculture Pratique, t. 2, 1898, pp. 348–349.

are data pertaining to the physical conditions of the soil, its texture, component parts, aeration, drainage, humus and water content, biological factors, and the health, vigor, and yield of the plants growing thereon.

Nothing short of practical trials of fertilizer materials will determine just what the needs of an orchard are. While cover crops perform excellent service in several ways, they must be supplemented in the older orchards with phosphoric acid, potassium, and possibly lime. As a result of extended work upon California soils, Dr. Hilgard advises that it will be safest to begin with phosphate; if unsatisfactory, apply nitrogen; and if anything further is needed, use potash.

Each orchardist must solve his own problem by varying the treatment to meet the different soil conditions. Granting that the soil conditions are of average adaptability to the walnut, specific requirements are a generous supply of humus, available nitrogen, phosphoric acid, and potassium, with ample aeration and biological activity. Cover crops supplemented by mineral fertilizers are usually most economical. Advice may be sought of the chemist of the State experiment station, and it is desirable to consult the experience and studies of station experts upon the various phases of orcharding.

As a series of first trials, it is suggested that one part of the orchard to include its various soil types be planted with a cover crop of legumes and another part with nonlegumes. On parts of each of these areas soon after growth has started use different minerals or mixtures, preferably plowed under or disked in with the cover crop. For example, about each of several trees, say from 12 to 20 years of age, use 5 to 15 pounds of superphosphate and about each of several others twice the amount. On another part of each cover crop area, leaving at least two trees between the different trial groups, give several more trees twice as much superphosphate. About trees of another group put 4 to 12 pounds of sulphate of potassium and about the trees in yet another group 8 to 20 pounds. To other groups supply a mixture of the two substances in the above proportions. Such tests varied by years or pursued more than one year should afford results of much value to the orchardist.

Ralph McNees, of Whittier, Cal., in a letter reporting his experience, says:

> My grove is located upon very deep, rich, dark clay soil. Until recently I have been able to secure enough stable manure to give my orchard a good dressing each year, which, with a crop of bur clover to turn under each year, has kept up the fertility of the soil and supplied the necessary humus without having to resort to the use of chemical fertilizers. Recently it has become difficult to secure sufficient stable manure, and I have depended upon the nitrogen-gathering cover crop to supply the necessary nitrogen and to bring up the potash with which our soils appear to be well supplied. In addition, I have added about

one-half ton of superphosphate per acre. At the same time I have used all the stable manure that I could readily procure. My crop varies but little from year to year, and orchards that were alternate bearers before are now under this treatment annual bearers. My aim with this treatment is to keep the tree vigorous and making good annual growth; this insures regular bearing and good crops. A fellow grower has accomplished the same or even better results by growing an annual crop of vetch, and after irrigating it by the furrow system whenever necessary to insure a full crop plows it under in July. Of course the character of the soil, the number and age of trees per acre, cultivation, and irrigation will all tend to influence the yield. But two conditions are evident in the vetch treatment: First, an increased amount of available nitrogen; second, a largely increased humus content; both of which are important factors in walnut growing.

INTERCROPS.

Should an intercrop like beans be grown, a not uncommon practice in parts of southern California while the trees are young, returns from such crop may be expected to net $20 to $50 per acre, while the straw and chaff are returned to the soil as fertilizer. In some sections tomatoes, cabbage, squash, melons, and similar crops are grown among the trees during the first few years. Potatoes, beets, and similiar root crops attract gophers, which eat the young roots of the trees and do much damage. The returns from intercrops vary, but approximate the returns from the bean crop under like conditions. Under exceptional local or seasonal conditions the income from the melon or tomato crop may be materially larger, and in an exceptionally poor year the returns from the intercrop may be nothing at all.

It must be kept in mind that the intercrop is taken off merely as a loan upon soil resources that properly belong to the orchard and that if too long or intensively continued the practice may work to the disadvantage of the trees. If the intercrop must be grown restitution may be made by cover crops and fertilizers.

FILLERS.

Fillers are sometimes used instead of intercrops to occupy the soil more completely during the earlier years. The practice involves extra outlay, but may yield a corresponding revenue. The filler crop varies with the district. In California it may be peaches, plums, prunes, oranges, or lemons; in Oregon, prunes, early-bearing apples, or cherries. It is seriously debatable whether on the whole it is not better to avoid the use of fillers entirely, though much depends upon the individuality of the orchardist. Within bounds fillers may be employed to advantage, but if allowed to prejudice the normal development of the main crop they become an injury not compensated by the income which induces its employment. Not only do fillers require the care and attention of the cultivator at the same time that they are needed by the main crop, but they draw heavily upon the food and water resources of the soil as they become older. With the owner's

interest temporarily occupied with the crop that brings the earlier returns it frequently occurs that he overlooks the fact that the main crop, though yielding little or no revenue, requires to be supplied with ample food, water, sunlight, and air, all of which are being taken from them by the activities of the filler crop. If fillers must be utilized let it not be forgotten that additional food and water supplies must be provided if the principal and the secondary crop are both to succeed.

PESTS AND DISEASES.

BLIGHT.

The walnut serves as host to several insects and a few fungi, but the records indicate that few of them are serious foes to the tree or its fruit. Among those that do considerable damage year by year, blight or bacteriosis is most destructive. The bacterium causing this disease was discovered and named *Pseudomonas juglandis* by Newton B. Pierce, formerly of the Department of Agriculture, while conducting research investigations in plant pathology in southern California in 1896. For a few years prior to that date, and even since its discovery, this organism had been a menace to the walnut industry, particularly of this southern district. At present, evidence of the blight is found in nearly all localities of the Pacific coast, where the walnut is cultivated commercially. It has also appeared in several parts of New Zealand with disastrous results, but is not elsewhere reported.

The damage is manifest chiefly in the young shoots and nuts. The affected shoots wilt, turn black, and die back from an inch to a foot or more (usually 3 to 6 or 8 inches). On young and rapidly growing trees the injury is often very serious, though as yet no record has been made of a tree being killed by blight. The injury to the nuts occurs about blossoming time, when there is little development, and the very small nuts fall from the tree. Those attacked at any subsequent date may either fall or remain until the tree is poled, depending on the virulence of the attack. Poling is performed by shaking or striking the limbs with a long pole having an iron hook at the end.

The disease attacks the hull from the outside (fig. 19, *c*) and gradually passes inward, destroying more or less of the shell—though often only discoloring it, in which case the nut remains on the tree—and later shriveling and blackening a part or all of the kernel. Blighted nuts usually fall prematurely, but sometimes remain on the trees to the end of the season. Figure 19, *b*, illustrates a group of unblighted young nuts of the same age as figure 19, *c*.

Blight appears with the first vegetative activity in spring and develops rapidly in moist warm weather. The period of most destructive activity usually lasts not more than 10 days. In 1910, at

Saticoy, where fog prevails to a far greater extent than at Santa Paula, the orchards were much less seriously affected.[1] Saticoy is nearer the ocean than Santa Paula, and perhaps the temperature during early growth was more favorable.

That blight has become a disturbing factor in the crop output of the California walnut orchards is evidenced by the fact that one firm with an established bearing orchard of 500 acres has removed the trees from 65 acres and is seriously contemplating the clearing of 75 to 100 acres more because the blight is particularly destructive in that part of the orchard.

Well-known orchardists in charge of large properties assert that the loss from blight in 1910 approximated one-tenth of the crop. The fruit of some trees was injured to the extent of 10 per cent, of others 60 per cent, while some were but slightly injured. The total loss, in round numbers, to the industry must have been over a quarter of a million dollars.

Both National and State Governments have realized for some years that the problem of combating the blight is serious, and each has conducted in its own way very complete investigations covering the subjects of remedies, especially the application of sprays. The investigators employed by both the Nation and the State are agreed that spraying offers no sure means of combating blight. Extended but incomplete observations made over widely separated areas indicate the possibility of partly overcoming the effects of blight by the use of fertilizers which stimulate the trees to an increased yield, and also that irrigation promises similar results.[2] Definite results from more extensive and completed experiments are awaited with much interest.

The latest findings relative to blight are by the University of California experiment station, from whose Bulletin 203 the following excerpts are taken:

> The ultimate solution of the blight problem appears to be in the growing of walnuts immune to the blight, desirable types of which are already in existence. Much work is being done at the Whittier laboratory in this direction. This involves the growing of grafted rather than seedling trees, and thus opportunity is given for choice regarding both the root and the top of the tree. Each is of great importance. Extensive plantings have been made at the laboratory of nuts of various kinds and sources for the production of root stocks. These represent several species of walnuts and also hybrids between different species. Experience has already shown that in the native California black walnut we have a more hardy root than that of the English walnut, one that is more capable of flourishing under unfavorable conditions and one with a much wider range of soil. The native walnut varies, however, in individual

[1] Observation of C. C. Teague, president of the Southern California Walnut Growers' Association.

[2] Bulletin 203, California Agricultural Experiment Station.

trees almost as much as the cultivated species, so that there is room for careful selection and discrimination in growing a root stock. The California walnut is also divided more or less distinctly into two separate species. It may be classed as the southern California and northern California types. The tree which grows wild in the southern part of the State has its favorite habitat upon dry, somewhat elevated hillsides, with occasional trees in the valleys at the foot of these hills. It is distinctly a hillside rather than a valley tree, however. The tree itself has quite a shrubby rather than a treelike form, and even in large specimens grown on good soil with abundant water the tendency is still toward abundant branching rather than the formation of a tall, clean trunk. * * *

The origin of the northern California walnut is much in doubt. While this tree is one of the commonest grown for shade and ornament about many of the towns in central and northern California, yet there are only a very few places where there is any indication of the tree having been indigenous. Considerable attention has been given to this interesting question, and we have found but three locations where the walnut trees go back beyond the knowledge of any white person. These are (1) near Walnut Creek, Contra Costa County; (2) Walnut Grove, Sacramento County; (3) a point in the mountains of Napa County northeast of Napa City, near the top of the west slope of the so-called "Wooden Valley." In each of these places, and at no other which we can find, there were large, old black walnut trees growing at the time of the first white settlement. These primeval trees do not appear to have been indigenous to the localities where they are found, but the question of their origin is an extremely obscure one. Morphological and field studies are being made by Mr. Ramsey upon this subject. The northern tree shows a decided preference for a moist valley soil in the vicinity of streams rather than that of the south for growing on dry hillsides.

Both the northern and southern California walnuts have been found satisfactory as a root stock for the English, but we have as yet no sufficient comparison between them to judge finally as to which is the better. Such comparisons are now being made by this division by grafting English walnuts on various roots and planting them in various soils. The possibility of using for roots some of the not uncommon hybrids between the California black, American black, and English walnuts is also receiving much attention, on account of the extremely vigorous growth of these trees. Selected walnuts from all over the State as well as from other parts of the country have been planted at Whittier, and a very interesting nursery is in process of development.

The selection of a strain or variety of English walnut possessing immunity to the blight as well as desirable commercial qualities is receiving much attention. Immunity to this disease is not obtained entirely by actual resistance, but in many cases by simply escaping the worst infection period, i. e., the moist weather of early spring. Most of the immune trees are such as come out rather late in the spring, thus escaping rather than resisting the blight. Several of the ordinary French walnuts, such as the Franquette and Mayette, have this quality of lateness in an extreme degree, but this involves the question of the time of harvest in the fall, an extremely late crop not being desirable in California. The most promising trees found thus far are local seedlings of foreign varieties which develop somewhat later than our ordinary seedlings, but not so late as the French varieties mentioned. A number have been found which seem to justify their planting as blight immune. Among these we may mention varieties which have received the names Eureka, Concord, Chase, and San Jose, as well as the Franquette and Mayette mentioned above. All of these and many other varieties are being grown by this division and their value

carefully tested for various portions of the State. We are now in a position to supply scions of all the important walnut varieties, as well as a limited number of nursery trees of some.

One very imperative phase of this matter has been the question as to the fate of the present existing plantings, consisting of many thousand acres of fine, large, thrifty trees, very satisfactory in every way except for the occasional loss of a considerable part of the crop through their susceptibility to the disease. Many of these orchards are extremely profitable even under present conditions, and it is evident that by increased attention to soil fertilization their productiveness can be maintained in a very satisfactory degree in spite of the disease.

One means of handling large trees which are extremely susceptible to blight is by top grafting them to the more immune kinds. The methods of doing this have received the consideration of this division, and much work has been done along this line. During 1908 and 1909 a considerable number of large trees were top-grafted, both by the station and by individual growers, with decided success. Experience elsewhere, particularly in the central part of the State where many large native walnuts have been grafted to the English variety, has shown that with reasonable success a new top equal to the original one can be put on a large tree in four years. In orchard work the most rational practice appears to be the picking out and working over of the trees most susceptible to blight each year until finally the whole orchard has been changed. In this way there is no marked loss from cutting off the trees in any one season.

Another method of working over an old orchard consists in intersetting with nursery trees of the California black walnut. It is more practical to plant the young trees rather than the nuts in the orchard. The object of this method is to grow the black walnut trees up to 3 or 4 years old and then graft them in the top to the desired variety. If the ground is closely shaded by old trees, they should be thinned enough to give the young black walnuts a chance to grow. This thinning can be done in most of our older orchards without any disadvantage, as in most of them the trees are already too thick. The young grafted trees will come into bearing early, and it is possible by this plan to have a new orchard well started by the time it is necessary to cut out the old trees. The advantage of a tree having the black walnut trunk as well as root is a very considerable one, owing to the susceptibility of the English walnut trunk to sunburn.

The extensive work by the University investigators entitles their views to great weight and those contemplating the planting of walnuts, particularly upon the Pacific coast, will do well to give them careful consideration.

SUNBURN AND PERFORATION.

The damage resulting from sunburn and "perforation" is occasionally serious enough to affect the value of the crop slightly. Sunburn blackens both shell and kernel, thus injuring the sale of the product. Perforation is denoted by the failure of the shell to fully develop or fill out. Sometimes the injury is in the nature of small openings through the shell; or, more frequently, very thin places. Both troubles apparently are due to unfavorable physical conditions.[1]

[1] A fuller discussion of sunburn and perforation will be found in Bulletin 218 of the California Agricultural Experiment Station.

INSECTS.

Occasionally other pests attack the walnut tree or its fruit, but no considerable damage has been reported. In a few instances the walnut aphis has caused slight damage. Other insects that attack the walnut are borers, which work in the trunks of the trees, several species of Lepidoptera, which feed upon the foliage in the larval or caterpillar stage, and the nut weevils, which feed upon the fruit and in some cases on the terminal twigs. Growers encountering insect pests should send specimens and damaged parts of the tree to the Bureau of Entomology, United States Department of Agriculture, Washington, D. C., with a request for information as to the ways and means for combating them.

HARVESTING THE CROP AND PREPARING IT FOR MARKET.

HARVESTING.

The most important phase of harvesting the walnut crop is to prevent the nuts from becoming stained. The market demands that the nuts be a clean, bright-yellowish hue. This requirement may be met in two ways: (1) By care in harvesting to prevent the shells from being soiled with dirt, stained with dye from the hull, or discolored by rains or strong sunlight; (2) by bleaching after being cured.

The outer hull of the Persian walnut ordinarily breaks along irregular lines when mature and permits the nut to fall free to the ground. During dry seasons part of the crop fails to do this or to fall from the tree at all until outside force is applied, usually in the form of poling or shaking. In normal years it is necessary to pole tardily maturing nuts to keep the harvesting period within reasonable limits. Such polings usually also require hulling.

By extreme care in harvesting it is possible to escape the need of bleaching. The natural color of most varieties if fully preserved is sufficiently light to meet the demands of all but the most fastidious purchasers. Let the grower exercise the following precautions: So far as possible gather the nuts just as the hulls open to free them. Allow none to remain long exposed to direct sunlight, rain, or dew, or in contact with the soil, or attached to parts of the broken hull. Let freshly gathered nuts remain for only the shortest time possible in picking boxes, sacks, or other receptacles before subjecting them to the cleaning process. Care must be taken that the nuts are not kept too long in water, as such treatment is liable to partly unseal them. A spray of water playing over a slatted revolving cylinder fully serves the purpose. Twelve to fifteen minutes' active rolling and rubbing is ample to remove soil particles and the hull fiber from the nuts. Then remove the nuts to slatted trays 3 by 6 feet and 3 to

6 inches deep. If the sunlight is intense the trays are placed in a shaded area, as under partially defoliated trees or light screens, where a current of air rapidly absorbs the excess water of the cleansing bath. If the rays of a declining sun are not too hot, the trays are spread on the ground (fig. 23) or on low horses in an open space. Prolonged exposure to a hot sun discolors the shells and sets oil free, which hastens rancidity when the nuts are afterwards stored. Should fall rains attend harvesting operations, place the trays in an artificial dryer where a current of moderately warm dry air may be passed over the nuts for a few hours.

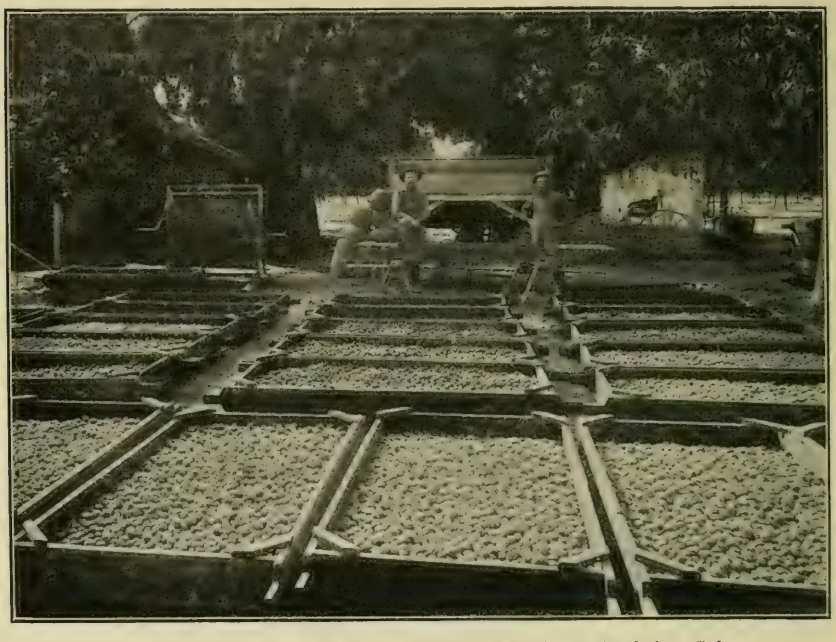

FIG. 23.—Screening and curing Persian walnuts at Anaheim, Cal.

CURING.

After being subjected to this preliminary drying process 10 or 12 hours in the case of the dryer and 3 to 5 days when exposed to the open air the trays of nuts are stacked in tiers 4 to 6 feet high for a week or 10 days, during which the nuts cure, or they may be placed in bins which permit free circulation of air, and should receive frequent turnings. After being fully cured they are graded by passing them over an oscillating inclined plane of wire screen or through an inclined cylinder of the same material, the slightly oblique mesh of which varies from 1 inch to $1\frac{1}{64}$ inches square. With either apparatus the motion is slow, not more than 10 or 12 revolutions of the cylinder per minute or a corresponding number of oscillations of the plane.

HULLING.

Nuts which fail to free themselves from the shell at the time of falling from the tree (called "sticktights") are hulled by hand or put through a machine similar to a corn sheller (fig. 24). For a large quantity the machine method is quicker and cheaper than the hand method. Sticktights are usually due to want of water just prior to ripening. In dry seasons, where possible, a moderate application of water should be given the trees just before the hulls complete their growth. This treatment promotes plumpness of the hulls, which in consequence separate freely from the nuts.

FIG. 24.—Hulling and sorting Persian walnuts near Santa Barbara, Cal. The nuts travel on endless belts directly from these operations to the drying trays.

ASSORTING.

Having passed the grader, which separates them into two grades, the nuts are next more or less closely hand picked. This assorting operation removes ill-formed, discolored, sunburned, and blighted nuts, and those with broken or perforated shells. In some instances, especially when the crop is wholly prepared at home, the hand picking is done while the nuts are passing over the grader. In the smaller processing plants assorting, generally performed according to a very liberal view of what constitutes standard grades, is done at any stage from grading to sacking as convenience suggests.

PROCESSING.

When commercially considered the southern California crop is usually processed, because under present demands for a bleached

nut this operation offers the easiest, cheapest, and most expeditious means of handling the crop. Processing is responsible for a number of practices that are distinctly local, such as gathering the nuts at less frequent intervals than where processing is not practiced, and grading, bleaching, assorting, sacking, and selling in a specially equipped central plant on a basis determined by representatives of both grower and dealer. When the nuts are sufficiently cured at the orchard they are sacked and taken to the processing plant at or near the shipping point, where they are received and weighed, the grower being given a receipt for each lot as delivered.

To secure a uniform product the selling associations issue instructions to the growers covering details of the various harvesting operations. As the associations are composed of the growers as stockholders it amounts to the issuance by the growers of a set of rules for their own guidance in cooperative effort. The following instructions, issued by the Los Nietos and Ranchito Walnut Growers' Association, of Rivera, Cal., are representative of the action taken by such organizations in southern California:

ASSOCIATION INSTRUCTIONS.

Picking.—The nuts should be picked up as soon as practicable and not allowed to lie on the ground for any great length of time. The sun or fog will injure the meat of the nut or mar the appearance of the shell. Especially will this be the case where the outer hull adheres to the nut after it has fallen from the tree. The nuts should not be poled from the tree before fully ripe. A pole with an iron hook at one end will suffice to loosen the ripe nuts. Place the hook over the limb of the tree and suddenly jerk the pole; this will do the work.

Cleaning.—The nuts should not remain in the picking sacks for any length of time; if they do both the meat and shells are liable to become moldy, thereby injuring the quality and appearance of the nuts. The nuts should be thoroughly washed before being placed in the trays to dry and cure. The washing can best be done as the nuts are taken from the picking sacks and before the dirt adhering to the shell and the stain from the green hull dries. The cylinder washer will be found to be the best for washing the nuts. The time it takes to wash the nuts will depend on the condition of them, say from 10 to 20 minutes; use plenty of water.

Drying.—After the nuts are thoroughly cleaned they should be placed on trays in the sun, if not too warm, until thoroughly cured. The length of time will depend on the condition of the nuts and the weather. From 4 to 8 days will usually be sufficient. When the nuts are well cured the meats will be quite brittle; by this test you can tell when the nuts are properly cured. Care should be taken in drying soft-shell nuts. Too much sunshine will cause the nut to open; also the heat of the sun if very warm will start the oil in the meats, thereby causing the nut to become rancid. During foggy weather the nuts in the trays should be covered during the nighttime. This can easily be done by stacking the trays one upon the other and covering the top tray with burlap or any other material.

Blending plants.—While the blending plants are expected, so far as the appearance is concerned, to greatly improve our grade of walnuts, they will in nowise change the work of the grower in preparing the nuts for market, except sacking and delivering the crop to the walnut houses. It is especially recom-

mended that the growers, in delivering their walnuts to the association, use the ordinary grain or barley sacks, that the sacks be filled uniformly and sewed, and that the name of the grower be stenciled on opposite sides of each sack to prevent loss of identity of the nuts before being placed in the blending plant; and also to insure the return of the delivering sacks to the owner.

Twine.—The association will issue to stockholders, at cost, from the Rivera Walnut House on specific dates skein twine for the use of stockholders for sewing the grain or delivering sacks.

All walnuts will be weighed when received from the grower and receipt for net weight given. Payment will be made in accordance with the by-laws of the association as soon as accounts can be made up after shipments of walnuts begin.

After receipt of the nuts at the processing plant they are conveyed to the first of a series of power-operated machines, where they are screened from any foreign substances gathered with the crop. After screening they are passed through the bleacher and then through the grader, though sometimes grading precedes bleaching. The nuts are next taken to assorters on an endless belt and carried to especially constructed aerating bins from which they are sacked and shipped.

GRADING.

From the screening machine the nuts pass into and lengthwise through a cylinder about 20 inches in diameter and 5 feet long, made of standard-size wire screen. This cylinder, called a grader, is set on an incline of about 15° and when rotated slowly allows the smaller nuts to pass through the mesh while the larger ones pass out at the lower end, separating the nuts, though not very accurately, into two grades called firsts and seconds.

To the writer there appears to be a weakness in the present method of marketing the crop. The product of the average orchard ought to have its firsts again separated into two grades if the crop is to obtain the returns to which it is entitled in comparison with other orchard crops. The average difference in price between firsts and seconds is about 20 per cent, somewhat less when prices are high and rather more when prices are low. Ordinarily there is as much difference between the sizes of the nuts marketed as firsts as between firsts and seconds, with the proportion reversed. The usual proportion between firsts and seconds is 9 to 1. On this basis, regrading of the firsts would put 9 per cent of the crop in a grade above the present first grade. This part of the crop on the present price scale would bring to the producer a net profit of nearly 2 per cent above what is now received, since there would be no additional cost in making the new grade. Should the walnut crop of the future be grown in large part upon grafted trees the above sizes and prices may not hold, since the fruit from grafted trees is much more uniform than from seedlings. Data of Franquette, Wiltz, and Concord nuts grown,

respectively, in the Vrooman, Wiltz, and Hutchinson orchards of grafted trees show less than 5 per cent of seconds in the average crop and practically no variation in the size of the nuts rated as firsts. Should like results prevail in future orcharding, and leading authorities in all walnut districts are freely of that opinion, there may be little need to increase the number of grades in future except with reference to varieties. The trade requirements of the future will demand that grades be distinguished in other respects than by size alone. In addition to grading for size and its accompanying cracking percentage as at present, the interests of the industry make it evident that steps must soon be taken to insure grading on a more comprehensive basis. The nut trade suffers materially from insufficient discrimination in such points as the following: Form of nut; bleaching, sealing, uniformity in type, smoothness, regularity, color, and thickness of shell; cracking percentage; darkness, veining, and astringency of pellicle; lean or fat kernels; toughness, tenderness, crispness, flavor, and quality of flesh.

Were walnuts graded as closely as oranges, lemons, apples, and pears there would be at least one more grade, and probably two, which would bring the grower of extra-large or fancy nuts a corresponding advance in revenue, with added incentive toward raising the grade and quality of the output.

BLEACHING.

From the grading machine the nuts pass to the bleacher, a cylindrical piece of machinery similar in size to the grader but made of straight wire rods running lengthwise and held in position by encircling cross wires. After being sprayed with electrolyzed brine in passing through this machine, which, like the grader, is supported on an incline, the first-grade nuts are carried to a drying bin to remain for a few days, where air currents may circulate freely among them. Meantime the seconds separated by the grader are placed in sacks to await their course through the bleacher when the firsts have passed out. As the firsts and seconds leave the bleacher on endless belts for the finishing, aerating, or drying bins they are handpicked or assorted. The sorts, called culls or shells, are placed in separate bins and sold to confectioners or concerns that engage in the preparation of shelled meats for market.

Electrolytic bleaching is far superior to the chlorid of lime bath or sulphur fumes. Being simple in preparation, clean, and effective, it is less injurious to the nuts and more wholesome for the consumer, as little, if any, material gets into the nuts, and then only into those that are unsealed. The solution used is made by dissolving 5 pounds best-grade dairy salt in 100 gallons of water. This solution is placed in a battery jar and an electric current of 95 to

110 volts is applied. The variation in the strength of the current depends upon the purity of the salt. The cell containing the liquid is kept at a temperature of 90° to 95° F. It is applied to the nuts as a spray with a pressure of about 80 pounds.

As soon as the bleached nuts are dry they are sacked in the same manner as the wheat crop of the Pacific coast. In some instances, for convenience in identification while being handled, the sacks carrying the firsts have stamped upon them lengthwise a distinct colored band or broad stripe.

A perceptible opposition to bleaching is manifest on the part of those consumers familiar with both the bleached and the unbleached product. Undoubtedly some of this unfavorable criticism in the past has been deserved, since it is well known that the old process of dipping in chlorid of lime permitted more or less of the solution to enter nuts not well sealed, rendering them disagreeable to the taste. This objection is avoided by the bleaching process already described, known as the salt bath, in which the solution rarely enters the shell, and if it does, nothing more than a mild salty taste is detected. Another objection to bleaching, which further investigation may overcome, is that it prevents the proper curing of the kernel through the destruction of the enzymes or other agents that develop in the unbleached nut.

While the bacteriologist is settling this question perhaps we may ascertain how to harvest, cure, and market the crop without the necessity of bleaching. At present a limited quantity of unbleached nuts are so marketed and, so far as known, bring prices equally high. The public will soon learn to accept the natural-colored nut, provided it is clean, unstained, and sold at the same price. The problem involves change in harvesting practices, and doubt arises as to the possibility of producing as uniformly clean and bright an output as is now offered by electrolytic bleaching without materially increasing the cost of production. In the face of what promises to be a growing sentiment against bleaching on the part of consumers who require a high-grade or fancy nut, the grower is likely to order his product to meet the consumer's demand.

STORING.

In the main, the keeping qualities of walnuts are excellent, but in order to insure the best results in storage they should be kept in a cool dry room constructed to exclude insects; otherwise wormy nuts will result from prolonged storage. Exposed to damp, nuts soon mold or decay, and even when dry the nuts will become rancid if kept too long. Dr. Thomas A. Knight, writing in 1811, said:

I have subsequently found that both chestnuts and walnuts may be preserved through the whole winter nearly in the state they came from the trees by cover-

ing them with earth (as potatoes are usually covered in the gardens of cottagers) and mingling a sufficient quantity of moderately dry mold with the nuts to occupy the space between them.[1]

Such a practice might not be amiss for the orchardist keeping his own crop, but would be impracticable when the market demands a clean, bright, or bleached product. To meet this demand there appears to be only one course to follow, and that is to subject the crop to cold storage after being fully cured. A temperature such as is maintained for the storage of apples ought to be suitable for walnuts, though no reports of experiments upon this point have been made.

With walnuts that are to be stored for an extended period care must be exercised in the selection of thoroughly sealed nuts unless they are placed in air-tight chambers and kept cold. In ordinary storage chambers weakly sealed nuts are subject to serious damage by worms and weevils. Experiments now being made in the storage of pecans by C. A. Reed, of the Department of Agriculture, promise excellent results. Kernels cracked in 1911 were placed in vacuum-sealed glass jars, and on being opened in March, 1912 were found as crisp and fresh as when cracked. During this period the jars were stored in an office room at ordinary temperature. While storing walnuts commercially is somewhat different from this treatment of pecans in that the larger number of stored nuts will be unshelled, there appears to be no reason why the method should not give as good results with walnuts as with pecans.

WALNUT GROWING AS A BUSINESS.

PRODUCTION AND CONSUMPTION.

During the years of the past decade the quantity of walnuts marketed in the United States has been approximately as follows:[2]

TABLE III.—*Persian walnuts marketed in the United States, 1902–1911.*

Year.	Domestic unshelled.	Imported.		Price for the home product.[3]	Year.	Domestic unshelled.	Imported.		Price for the home product.[3]
		Unshelled.	Shelled.				Unshelled.	Shelled.	
	Pounds.	*Pounds.*	*Pounds.*	*Cents.*		*Pounds.*	*Pounds.*	*Pounds.*	*Cents.*
1902..	13,800,000	10,394,048	2,594,288	9½	1907..	15,096,887	23,036,646	7,199,988	11
1903..	17,400,000	8,936,439	3,035,970	10	1908..	14,674,543	21,427,853	7,098,958	15
1904..	12,628,248	19,454,012	3,579,941	12½	1909..	20,286,769	17,432,885	8,781,909	12½
1905..	15,175,994	16,312,139	4,178,010	11	1910..	18,695,686	23,269,974	10,960,988	11½
1906..	12,776,136	15,029,724	4,948,175	13	1911..	19,388,776	21,146,116	11,244,055	15

[1] Transactions of the Horticultural Society of London, ser. 1, vol. 1, 1820, p. 247.

[2] Reports for the years 1902 and 1903 by the Southern California Walnut Growers' Association. The data for 1904 to 1911, inclusive, are taken from compilations made by F. A. Hazzard from the record of shipments made from points in southern California.

[3] Net at the association's headquarters, less approximately 7½ per cent commissions.

According to the French ratio the shelled product is equivalent to slightly more than 40 per cent of the whole nut. The estimate of the total American consumption here given is based on this ratio for the imported product. It thus appears that the people of the United States during 1910 consumed approximately 35,000 tons of walnuts, more than 25,000 tons of which were imported. About five-sevenths of the importations came from France, while the larger part of the other two-sevenths came (in the order of the quantities imported) from Italy, Turkey in Asia, Austria-Hungary, the United Kingdom, and the Chinese Empire. Practically all of the home-grown commercial crop was produced in California, though Oregon sold a few carloads. A few thousand pounds were marketed from small orchards and individual garden, lawn, or roadside trees in Washington, New York, Pennsylvania, Maryland, New Jersey, and Delaware, while scattered trees in Michigan, Ohio, Virginia, West Virginia, Texas, and Georgia yielded a few hundred pounds for home use.

A great opportunity evidently exists for extending the area of production of the home crop. The present activity to secure hardier disease-resistant varieties of high quality and to improve the methods of propagation is evidence of the effort to take advantage of this opportunity. The interest of the public also suggests extended trial of the more promising hardy varieties over a wide range of such territory as appears at all suited to the successful cultivation of this tree.

YIELD.

There are authentic records of individual trees in Europe yielding as much as 2,000 pounds, while the largest yield recorded for an American tree is 712 pounds. This tree, known as the Payne tree, located at Campbell, Cal., is of magnificent proportions. It originated by the planting of a California black walnut in 1871. In 1896 the tree was top-worked with wood of the Santa Rosa Persian walnut. Though originally planted in a row with others, it grew so rapidly from the start that it soon overshadowed the others and has practically become an isolated tree, except for a white walnut, or butternut, some 60 or more feet away. Growing upon a deep fertile soil and fed by the wash of the barnyard, the crop of this tree is not a fair criterion by which to approximate the yield of a commercial orchard, though it has often served that purpose for the promoter of walnut orchards sold on the installment plan. In favorable seasons, with orchards growing upon deep rich soils well supplied with moisture, it is not unusual to harvest from an acre of seedling trees, 20 years of age, a ton or more of marketable nuts, but a conservative basis for investment is 1,000 to 1,200 pounds. The following statement from the books of a successful grower in the Rivera section of California

exhibits the results of an average orchard well managed. He had trees covering 8 acres 27 years old, 15 acres 16 years old, 12 acres 12 years old, and 7 acres 10 years old, which produced during 1910 nuts to the gross value of $5,200, or an average of $123.85 per acre. His approximate yield per acre was 825 pounds for 16-year-old trees. Statements of a yearly product considerably higher than these figures are frequently published, but careful inquiry among scores of successful growers in Oregon and California does not confirm them for average yields, one year with another, under varying conditions of soil and climate. It must be remembered, however, that statistics of yield from commercial orchards are taken at present almost exclusively from orchards of seedling trees, which are unquestionably less prolific than grafted trees of selected parentage. Though no authentic records are available, it is asserted that grafted trees of productive varieties, besides coming into bearing earlier, yield 20 per cent more nuts than average seedling trees. This estimate appears conservative when we consider that grafted trees may also be immune to blight. Further, the product of grafted trees brings a higher price upon the market. In the prices quoted for the output of the Southern California Walnut Growers' Association for 1910 nuts from grafted trees were favored by a $16\frac{2}{3}$ per cent advance over the general seedling crop. These two items are of weight when the factors in profitable orcharding are under consideration.

TABLE IV.—*Statement showing number of farms reporting Persian walnuts, trees of bearing and nonbearing age, quantity produced, and value, census of 1910.*[1]

State.[2]	Number of trees Apr. 15, 1910.				Products of 1909.	
	Bearing age.		Nonbearing age.		Quantity.	Value.
	Farms reporting.	Trees.	Farms reporting.	Trees.		
					Pounds.	
Alabama*	983	3,022	1,164	4,180	43,673	$3,557
Arizona*	23	103	62	324	1,000	161
Arkansas*	182	1,284	182	1,260	15,436	1,384
California	7,357	853,237	6,554	546,804	21,432,266	2,247,193
Colorado	6	39	7	80	25	3
Delaware	6	15	7	15	222	44
Florida*	301	786	327	1,489	28,575	2,018
Georgia*	1,020	3,433	984	6,996	56,585	4,161
Idaho	52	407	74	1,013	633	79
Illinois	87	772	12	1,045	3,497	331
Iowa	1	200				
Kentucky*	106	1,227	46	1,193	35,825	1,499
Louisiana*	411	1,228	398	3,390	15,173	1,446
Maryland	754	2,068	444	1,758	6,916	745
Minnesota	1	1	2	7	50	5

[1] The census tabulation shows no production of Persian walnuts in Connecticut, District of Columbia, Indiana, Kansas, Maine, Massachusetts, Michigan, Montana, Nebraska, New Hampshire, North Dakota, South Dakota, Vermont, and Wisconsin; but herbarium specimens and correspondence show that nuts of fair quality are grown in favorable sections of Connecticut, Michigan, and the District of Columbia.

[2] Observations and correspondence indicate that the enumerators in States marked with an asterisk (*) failed to distinguish between the product of the American black, the Japanese, and the Persian walnut. Students of horticultural conditions in these States, men of high scientific, professional, and business standing, assert that it is not possible to obtain such figures except by indiscriminate use of the term walnut.

TABLE IV.—*Statement showing number of farms reporting Persian walnuts, trees of bearing and nonbearing age, quantity produced, etc.*—Continued.

State.	Number of trees Apr. 15, 1910.				Products of 1909.	
	Bearing age.		Nonbearing age.		Quantity.	Value.
	Farms reporting.	Trees.	Farms reporting.	Trees.		
					Pounds.	
Mississippi*	893	2,705	1,239	5,513	66,492	$6,949
Missouri*	86	1,214	48	999	5,791	618
Nevada	8	39	11	148	200	20
New Jersey	170	429	138	1,360	2,798	302
New Mexico	15	250	123	1,641	715	91
New York	81	456	28	139	9,346	858
North Carolina*	563	2,125	509	1,731	73,303	3,686
Ohio	71	599	30	220	2,461	154
Oklahoma*	252	6,889	198	5,962	6,700	489
Oregon	1,134	9,526	4,300	177,004	79,060	8,288
Pennsylvania	53	198	68	142	4,523	516
Rhode Island	1	4	1	1		
South Carolina*	473	1,373	526	1,834	28,160	2,583
Tennessee*	96	437	49	137	4,157	295
Texas*	626	9,685	704	13,015	40,658	3,703
Utah	53	292	42	484	5,985	533
Virginia*	371	3,540	194	1,642	22,512	1,231
Washington	509	3,651	1,461	23,406	16,450	2,241
West Virginia*	121	3,035	59	1,481	17,337	2,153
Wyoming	1	1				

FOOD VALUE.

According to Prof. M. E. Jaffa, of the University of California, who has made extended analyses of the composition of nuts and other foods, walnuts, inclusive of the shells, are estimated to comprise a waste of about 58.8 per cent of the uncracked nuts as usually found upon the market. They have a value as represented by the heat units (calories) they furnish, pound for pound, comparable with other food products, as shown in Table V.[1]

TABLE V.—*Average fuel value of walnuts as compared to other food products.*

Food product.	Average price per pound, 1910.	Refuse.	Fuel value of edible portion.	
			Calories per pound.	Calories for 1 cent.
		Per cent.		
Round steak	$0.15		950	63
Wheat flour	.04		1,650	412
White bread	.05		1,215	243
Dried beans	.045		1,605	356
Raisins	.10	10	1,605	145
Walnuts	.25	58.8	3,075	51

[1] Yearbook, U. S. Dept. of Agriculture, for 1906, p. 299.

Considering the comparative value of walnuts and other food products, it is evident that the walnut can not be rated according to present market prices as an article of ordinary diet. Before the Persian walnut can become an article of daily consumption the crop must be produced in much larger quantities, necessitating extensive additional acreage. Relatively little high-class land suitable for the Persian walnut is available in southern California, except at very high cost. This region offers several thousand acres suitable for the production of this crop, provided care is used in the selection of site and varieties, though the fact is that much of this acreage will probably be planted to crops yielding earlier and more profitable returns. It will be necessary to enter other districts if the crop is to keep pace with the increased consumption, and preliminary tests warrant the statement that the crop can be successfully and profitably grown in other sections.

In connection with the topic of food value, it may be well to call attention to one or two features of the American-grown nut that merit attention, especially by those engaged in its improvement. The connoisseur of nuts is persistent in his assertion that the kernels of the French varieties when grown in the United States are much more starchy than when grown in France. He also asserts that many of our best American-grown nuts are more or less bitter and astringent.

These criticisms are not made in a spirit of disparagement but of helpful suggestion. It is assumed that if our nuciculturists have accepted ideals placed before them effort will be made to embody these ideals in American seedlings, insuring sooner or later a nut vastly improved in those properties that make a product of the highest quality.

At present the American public does not discriminate between the different varieties, types, or qualities of walnuts. When the home product shall equal or excel home consumption more discrimination will be shown. Already American growers are awake to the need of arousing the public to an appreciation of the fact that the first-grade home product is not to be classed with the foreign varieties generally used for replacement purposes.

It is opportune to have this matter of American quality brought to the attention just as we are beginning a notable advance in the improvement and culture of this nut, and to the criticism and demand of the connoisseur we shall be indebted for stimulation in the development of new and better varieties.

INVESTMENT AND OPERATION.

Though seasonal variations bring more or less change in the tillage operations of a walnut orchard, the following figures recording the

experience of growers throughout California, Oregon, and Washington may be considered a conservative estimate of the investment and expenses necessary to produce and market an average crop of walnuts. The average crop one year with another from trees 15 to 25 years of age is 1,000 to 1,200 pounds per acre.

In the States named first-class land suitable for walnut growing cleared and ready for planting costs $150 to $1,000 per acre according to location. In outlying sections, especially in northern California, Oregon, and Washington, land may be bought for $100 per acre. In sections where the walnut finds a congenial home higher prices prevail. Grafted trees cost $1 to $1.50 each; preparation of the soil and planting the trees, $4 to $6 per acre; pruning, 75 cents annually per acre as an average for the first 10 years; two or three times that amount for the next 10-year period, and slightly more afterwards; tillage, $12 to $20 per year if no intercrops are grown; irrigation, $2 to $6, according to character of soil, season, age, and bearing of the trees; fertilizers and cover crops (for nitrogen and humus) $2.50 to $5; superphosphate, $8 to $10; harvesting, $20 to $30 per ton; charges for processing, $10 per ton; commission on sales, 7½ per cent. The average price of the product during the past 10 years has been 12½ cents per pound f. o. b. at point of shipment on the Pacific coast.

NOTE.—Since the second paragraph on page 20 was written, the severe winter of 1911–12 wrought such damage to all Persian walnut trees on their own roots that it is necessary to change the tenor of the statements therein. Throughout eastern Pennsylvania and in the District of Columbia many old trees were killed outright or so severely injured that they will die within a year or two. In those instances, however, where the writer has made a personal examination the trees were found to be growing under the unfavorable conditions usually prevailing in the walled-up back yards of cities. A few trees growing under the more favorable environments surrounding country homes in this same territory have been reported as suffering severe injury from the low temperatures, —20° to —33° F., of January, 1912.

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PLATES.

DESCRIPTION OF PLATES.[1]

PLATE I. (*Frontispiece.*) A well-kept Persian walnut orchard in California, illustrating the thorough tillage that may be readily maintained among low-headed trees.

PLATE II. Varieties of walnuts—I. The principal species and hybrids now attracting attention in this country. Upper row, from left to right: Royal (*Juglans nigra* × *Juglans californica*), Paradox (*Juglans regia* × *Juglans californica*), Ignotum (*Juglans regia* × *Juglans cinerea*), Butternut, or white walnut (*Juglans cinerea*). Middle row: Siebolds Japan walnut (*Juglans sieboldiana*), Chinese walnut (*Juglans regia sinensis*). Heart-shaped Japan walnut (*Juglans cordiformis*). Lower row: American black walnut (*Juglans nigra*); (*Juglans californica*), northern form, California black walnut, southern form; rock or Texas walnut (*Juglans rupestris*), flat form; rock or Texas walnut (*Juglans rupestris*), long form; rock or Texas walnut (*Juglans rupestris minor*), Arizona form.

PLATE III. Varieties of walnuts—II. Top row, left to right: Bijou, Klondike, Honeydew. Bottom row: Hall, Payou, Meylan.

PLATE IV. Varieties of walnuts—III. Upper row, left to right: Grenoble, Santa Rosa, Persian, Sorrento. Lower row: Santa Barbara, Santa Barbara (Williams form), Santa Barbara (More form), Hardshell.

PLATE V. Varieties of walnuts—IV. Upper row, left to right: Mayette, Concord, Ward, Chelan. Lower row: Neff, Franquette, Parisienne, Nebo.

PLATE VI. Varieties of walnuts—V. Upper row, left to right: Two French seedlings (varieties on the same tree), Fertile, Chaberte, Cumberland. Lower row: Placentia, Mayquette, Kaghazi, Chase.

PLATE VII. Varieties of walnuts—VI. Upper row, left to right: Ford, Eureka, Rush, Prince. Lower row: Holden, Treyve, Payne, Prolific.

PLATE VIII. Varieties of walnuts—VII, Upper row, left to right: Alpine, Journeay, Mount, Cluster. Lower row: Vourey, Hubbard, Serotina, Late Fertile, Cutleaf.

PLATE IX. Varieties of walnuts—VIII. Upper row, left to right: Hales, Keesling, Milbank, Lane. Lower row: Hays, Lalande, Derby, Lea, Sinclair.

PLATE X. Varieties of walnuts—IX. Upper row, left to right: Chase 2, Chase 1, Kaghazi, Mayquette. Lower row: Pomeroy, Pomeroy seedling, Chaberte, Fertile, Dean.

PLATE XI. Varieties of walnuts—X. Upper row, left to right: Franmay, Prince, Wiltz, Glady. Lower row: Ellwood, Cumberland, Placentia, Persian (round).

[1] The bottom row in each instance is the lengthwise row next the plate legend.

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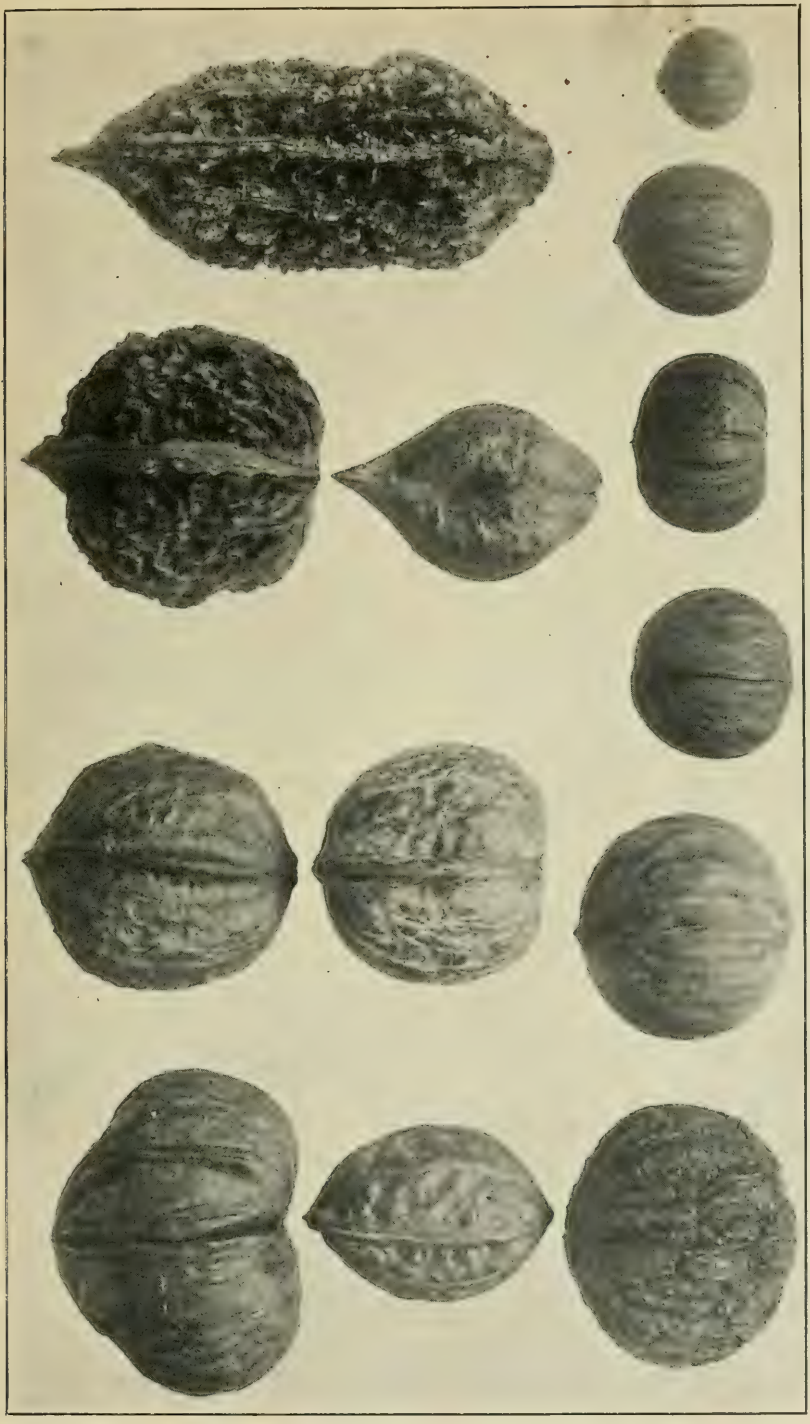

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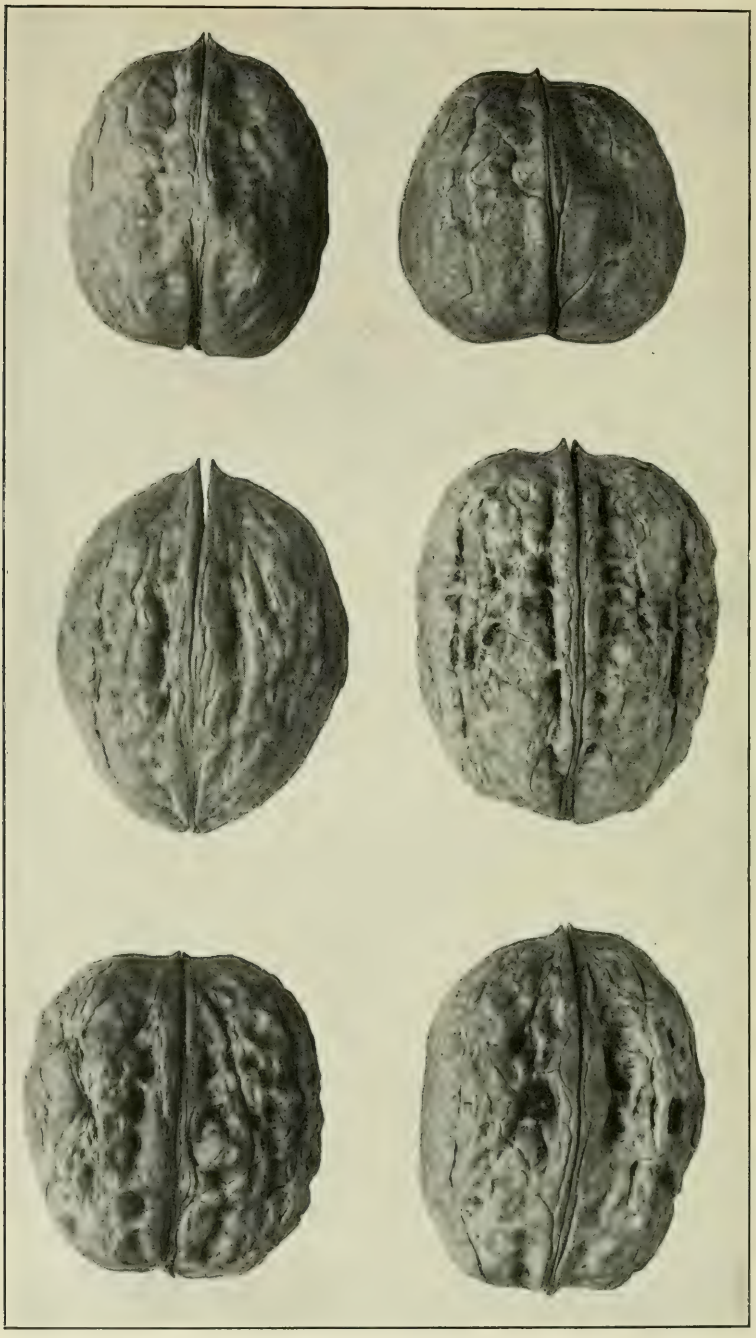

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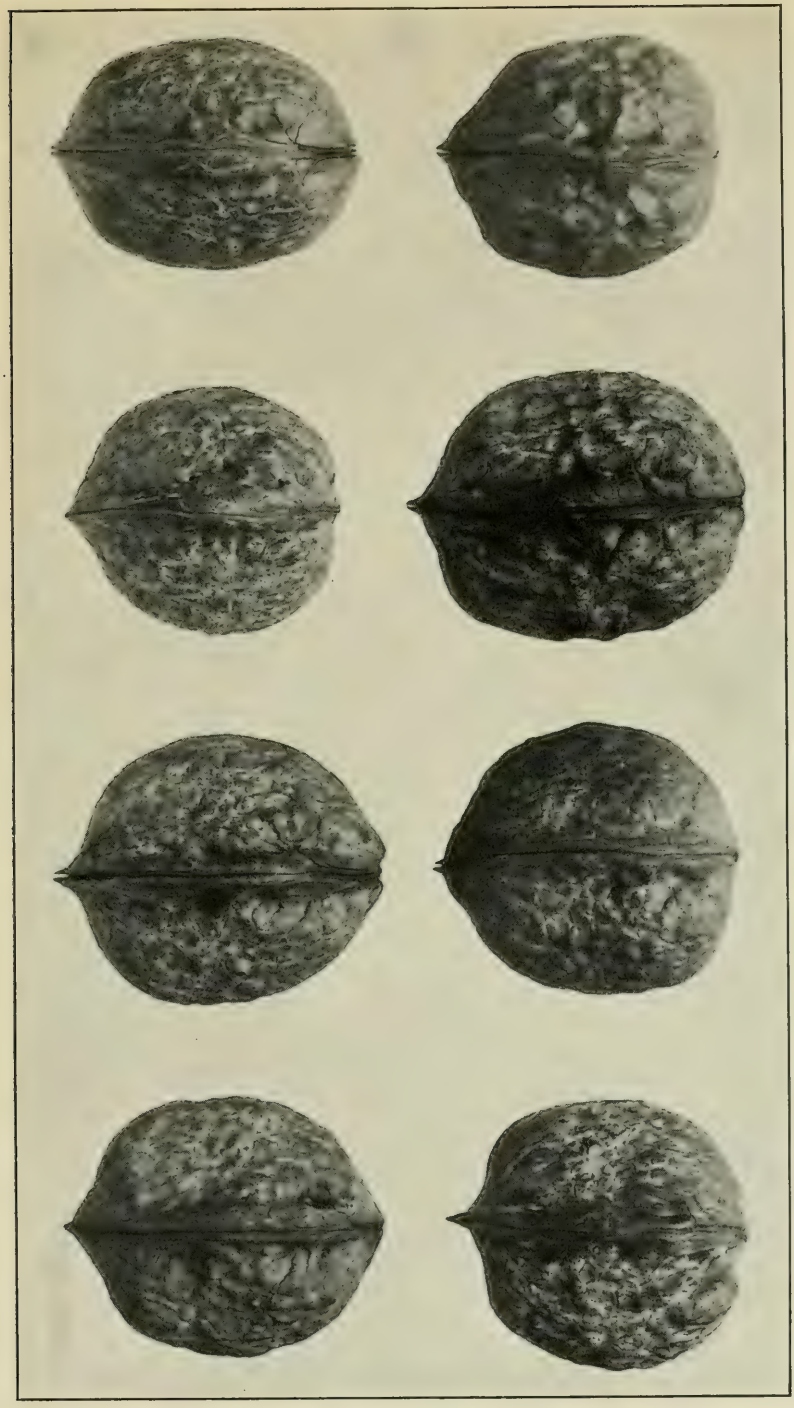

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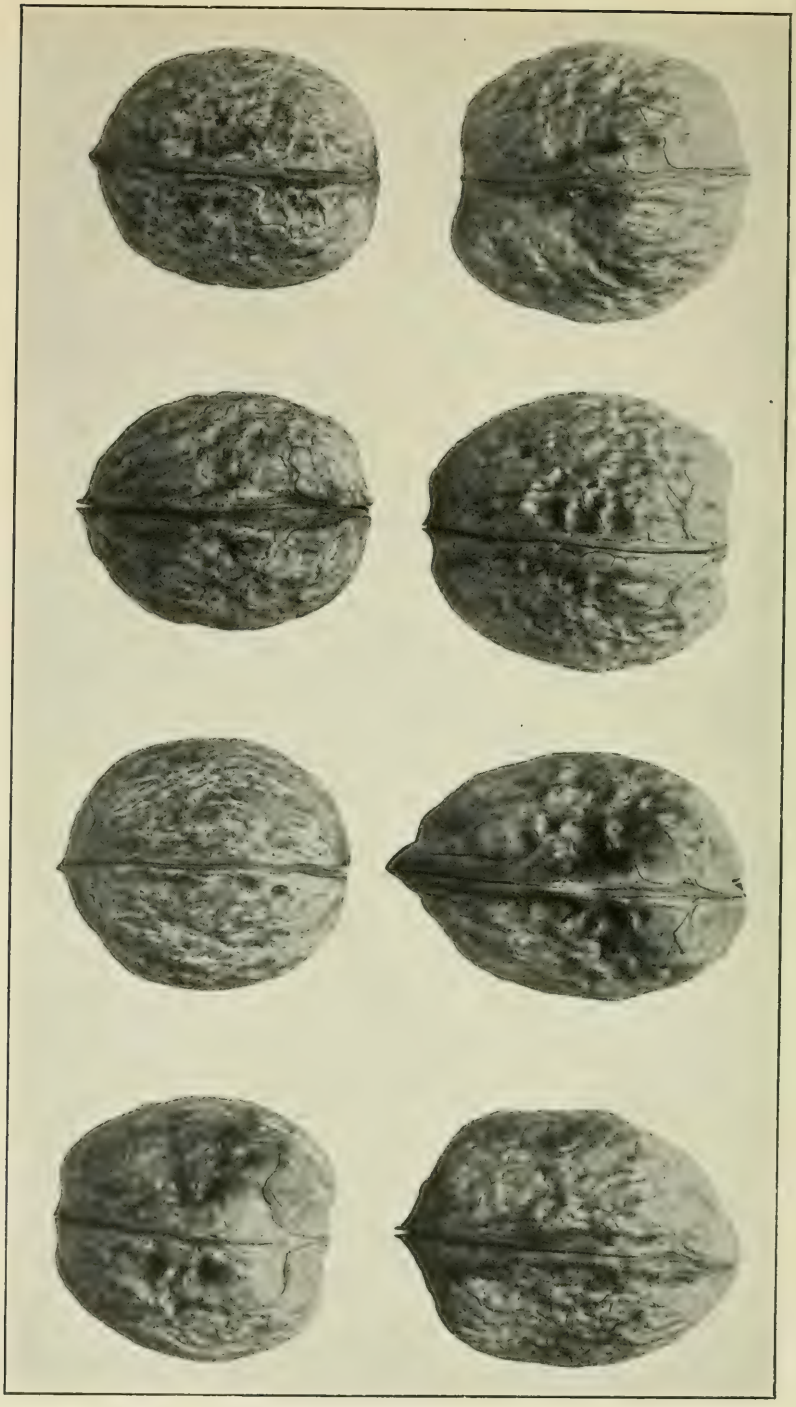

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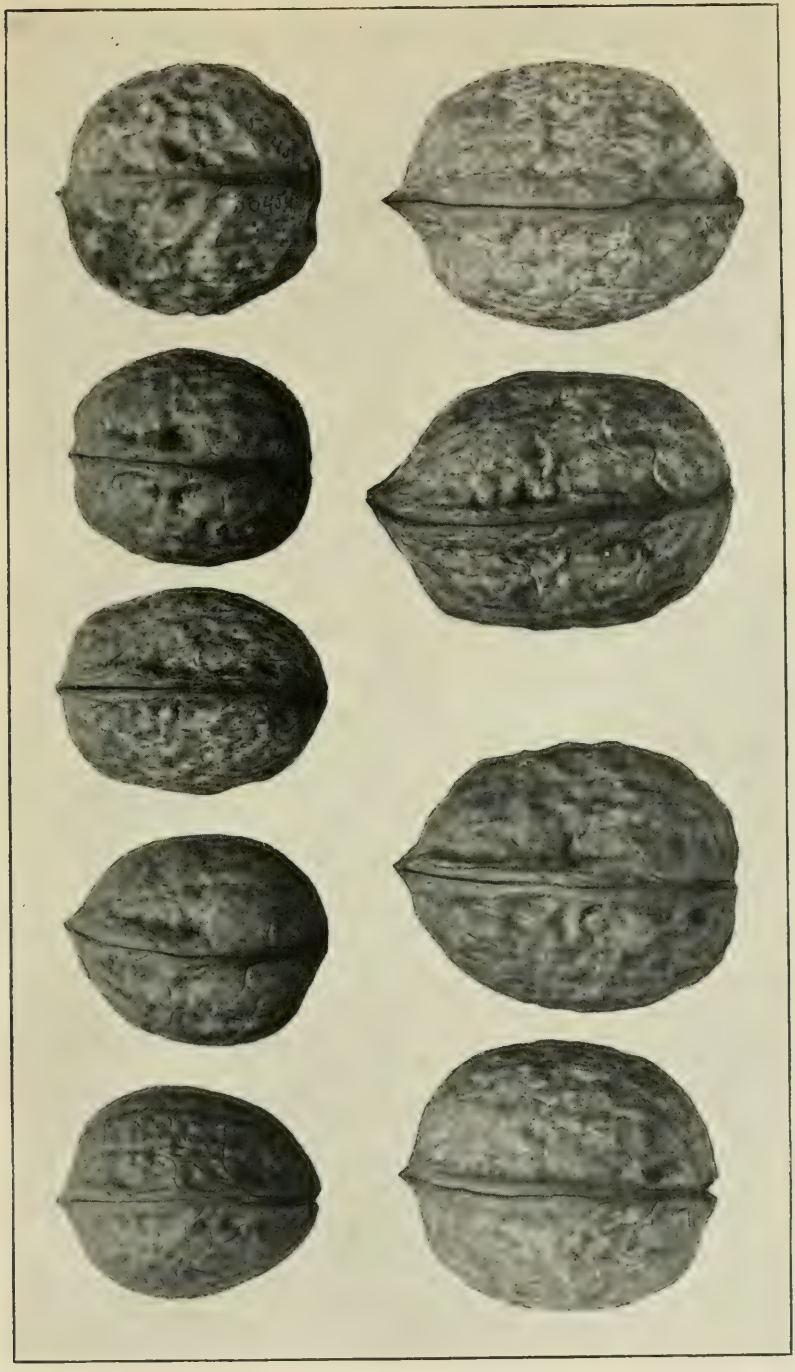

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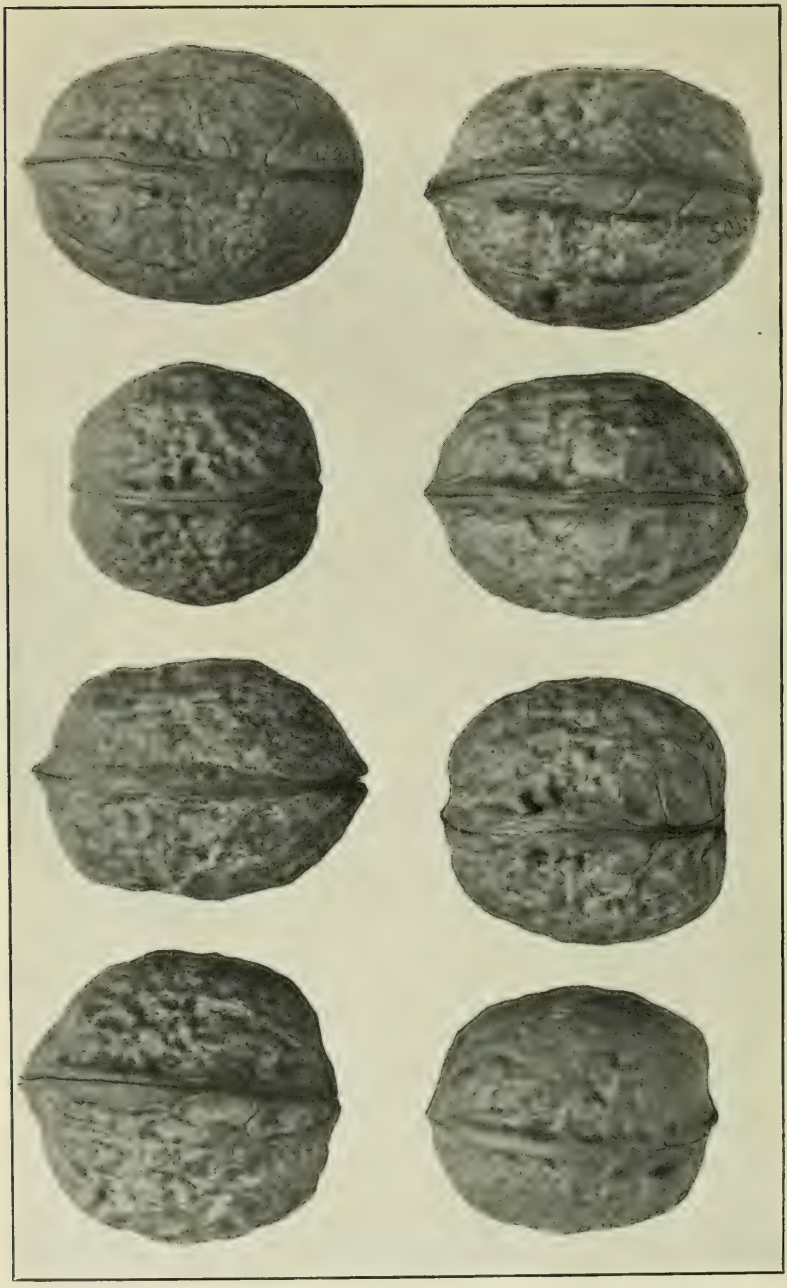

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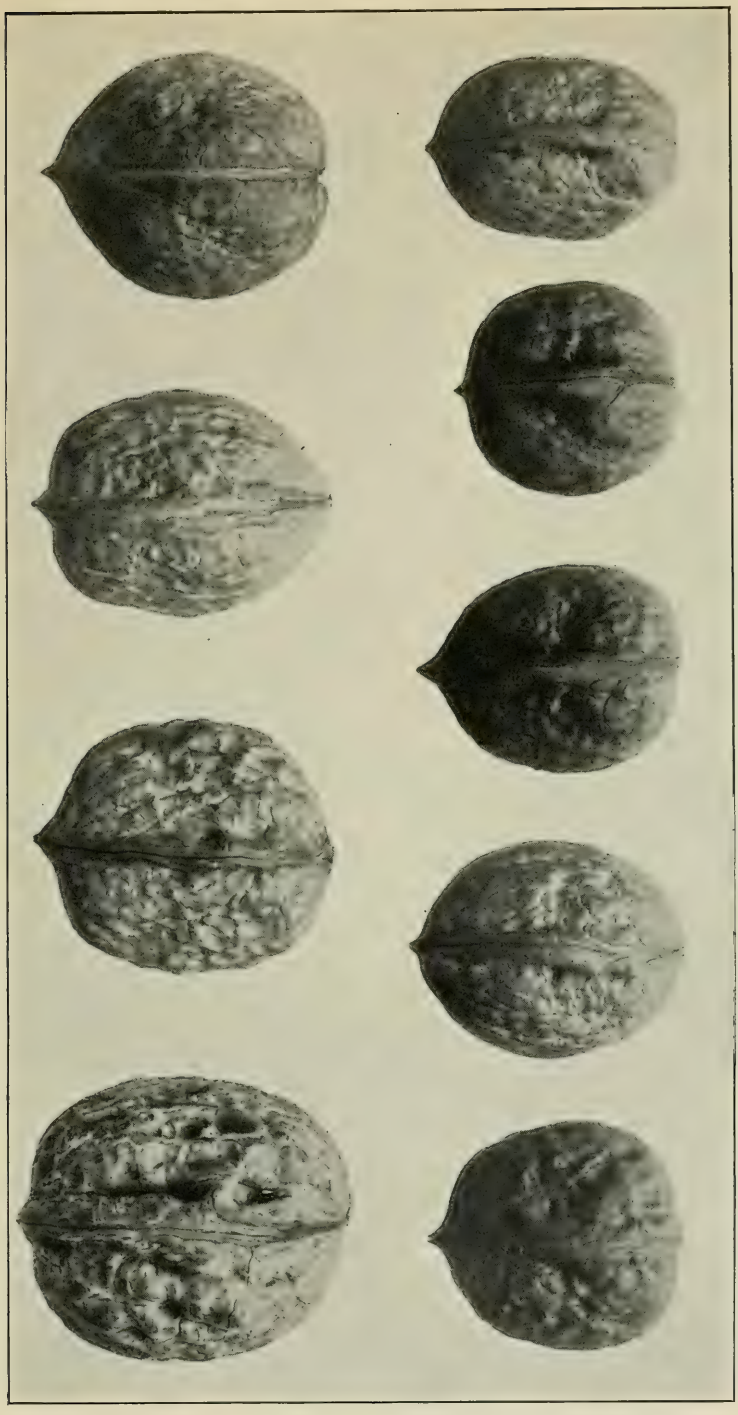

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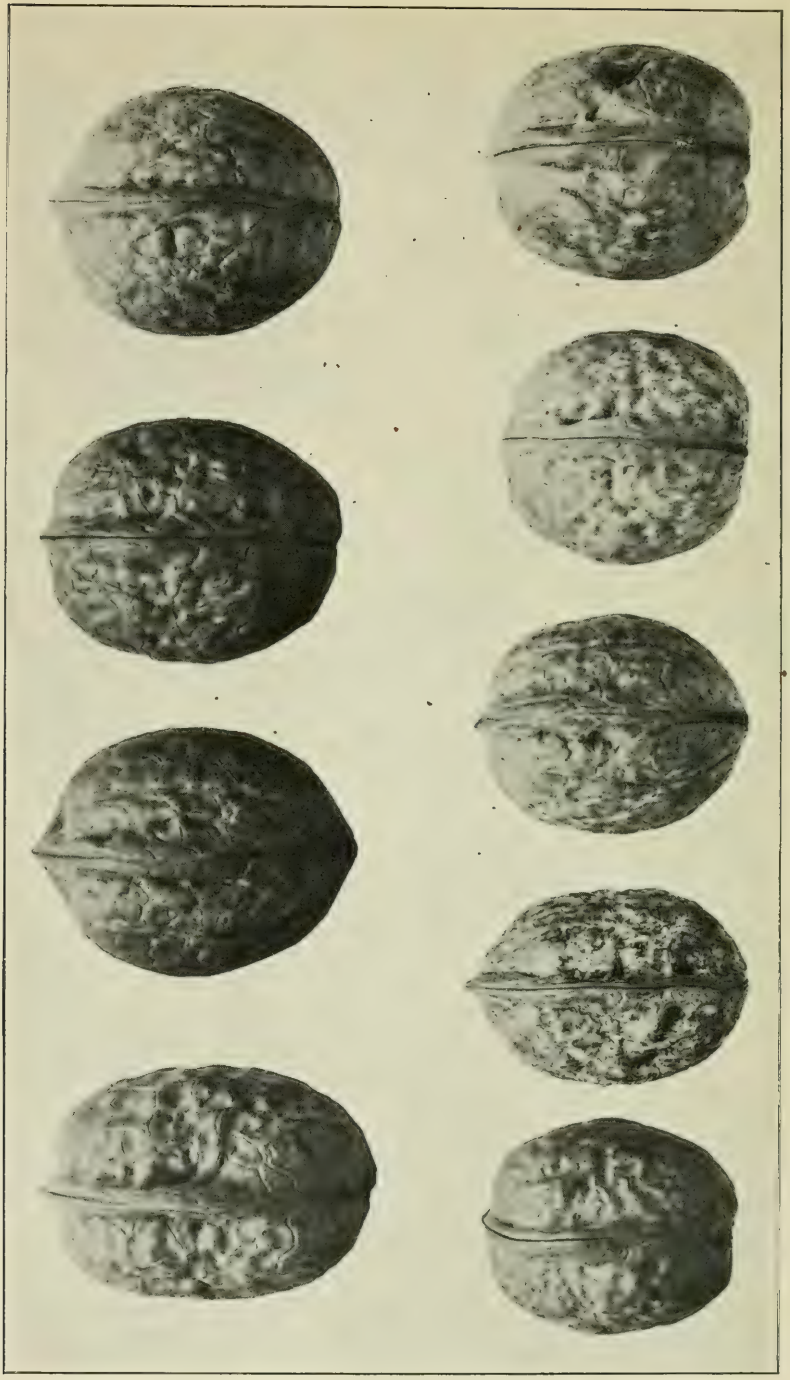
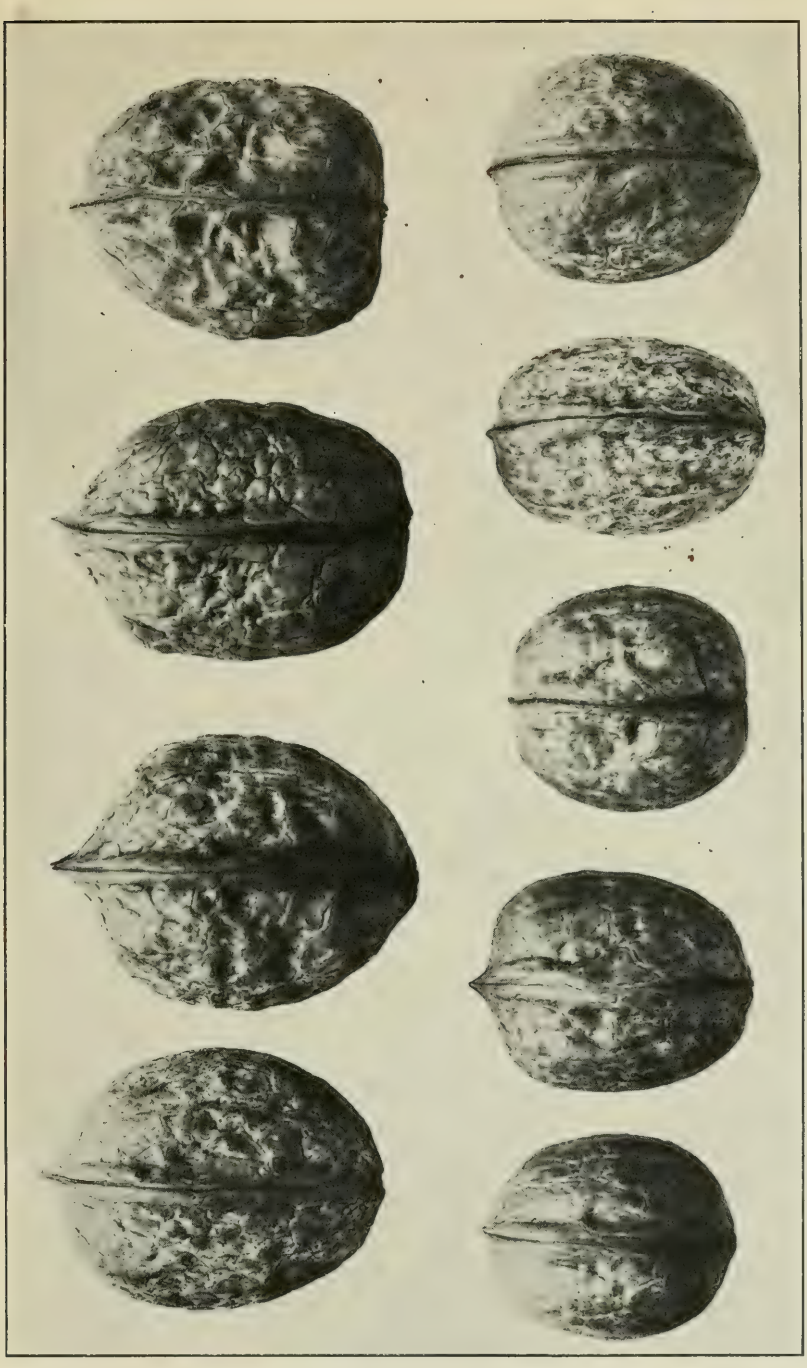
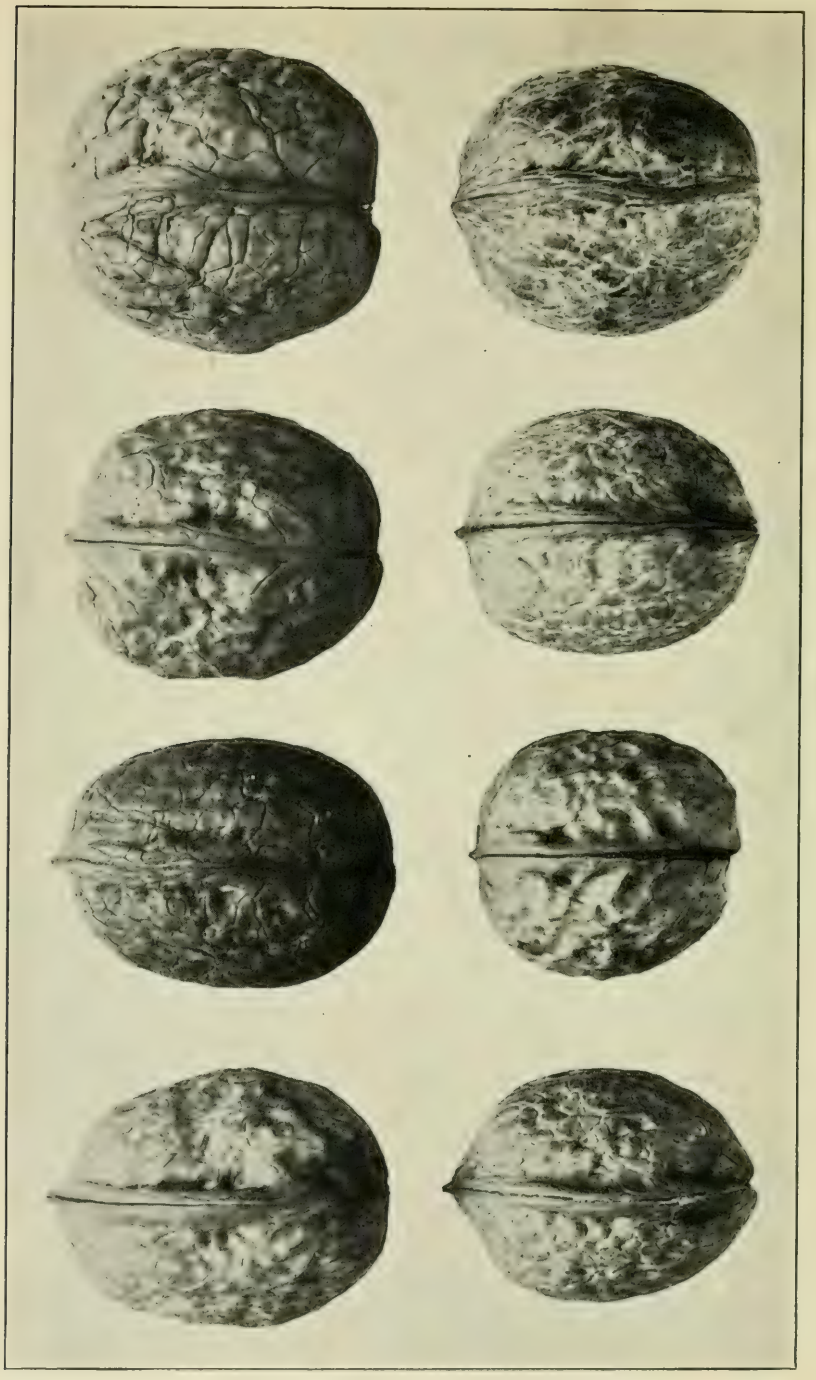


VARIETIES OF WALNUTS—VIII.



VARIETIES OF WALNUTS—IX.



VARIETIES OF WALNUTS—X.

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